ach^d to the Topographical Survey of Canada.

Commissioners

F. H. Peters, D.L.S.,
Surveyor General, for the Dominion of Canada

L. V. Rorke, O.L.S., D.L.S.,
Director of Surveys, for the Province of Ontario

Report of the Commissioners Appointed to Delimit the Boundary between the Provinces of Manitoba and Ontario from Winnipeg River Northerly

Survey by J. W. PIERCE, O.L.S., D.L.S., 1921 and 1922, under the Direction of the Commissioners

Topographical Survey of Canada
Ottawa, 1925

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Ottawa, September 5, 1925.

To the Hon. Charles Stewart, M.P., Minister of the Interior, Ottawa, Canada, Hon. James Lyons, M.P.P., Minister of Lands and Forests, Toronto, Ontario.

Your Commissioners, F. H. Peters, D.L.S., Surveyor General, representing the Dominion Government, and L. V. Rorke, O.L.S., D.L.S., Director of Surveys for Ontario, representing the Ontario Government, have the honour to make the following report on the survey of the Ontario-Manitoba Boundary from Winnipeg river to the twelfth base line of the Dominion Lands Surveys system, during 1921 and 1922.

(Sgd.) F. H. PETERS
L. V. RORKE
Commissioners.

CONTENTS

LIST OF ILLUSTRATIONS

CHAPTER I

HISTORICAL SKETCH

Original Boundaries of Ontario

Under the terms of Imperial Act 34 and 35, Victoria, Chapter 28, (British North America Act):—

> 2. "The Parliament of Canada may, from time to time, establish new Provinces in any territories forming for the time being part of the Dominion of Canada, but not included in any Province thereof, and may at the time of such establishment, make provision for the constitution and administration of any such Province, and for the passing of laws for the peace, order and good government of such Province, and for its representation in the said Parliament."
>
> 3. "The Parliament of Canada may, from time to time, with the consent of the Legislature of any Province of the said Dominion, increase, diminish, or otherwise alter the limits of such Province, upon such terms and conditions as may be agreed to by the said Legislature, and may with the like consent, make provision respecting the effect and operation of any such increase or diminution or alteration of territory in relation to any Province affected thereby."

Following closely upon the confederation of the provinces by the British North America Act, the Government of the newly constituted Dominion of Canada began the negotiations which led up to the Rupert's Land Act, and the acquisition by the Dominion of the title to Rupert's Land and the Northwest Territories.

As it was expected that the transfer of the Northwest Territories to the Dominion would be followed by the creation of new provinces under the terms of the British North America Act, some of which would border on Ontario, the Government of that province became interested in securing a precise definition of its boundaries on the west and north, and on November 3, 1869, the Lieutenant Governor in his opening address to the Ontario Legislature, in referring to the transfer to the Dominion of the Northwest Territory, stated, "I venture to suggest the propriety of your providing for an early ascertainment of the boundary line between that territory and this province."

In the correspondence which followed with this object in view it became evident that important differences existed between the views held by the legal advisers of the Ontario Government on the one hand, and those of the Dominion Government on the other, as to where the true western and northern boundaries of Ontario were, for these boundaries had not at that time been precisely defined.

Under the terms of the Treaty of Paris, 1763, the western limits of what at that time was known as the Canadas were "fixed irrevocably by a line drawn along the middle of the Mississippi river from its source to the river Iberville (Ohio), and from thence by a line drawn along the middle of that river . . . ."

Subsequently by Imperial Act 14, George III, Chapter 83 (Quebec Act 1774) it was provided that the province of Quebec included "all the territories, islands and countries in North America belonging to the Crown of Great Britain bounded on the south by a line drawn from the Bay of Chaleurs along . . . . . until it strike the river Ohio; and along the bank of the said river, westward to the banks of the Mississippi, and *northward* to the southern boundary of the territory granted to the Merchants Adventurers of England trading to Hudson Bay."

Other treaties had also been signed and other acts of Parliament had been passed during the period 1713-1867 which directly affected the boundaries of the most westerly province of Canada. Also a number of Royal Proclamations had been issued, and many commissions had been given to Governors General respecting the administration of this province and the protection of the settlers, and all these required careful consideration before the true western and northern boundaries of Ontario could be correctly ascertained. As the country to the west and north of lake Superior was not well known during the period 1713-1867, and maps were inaccurate it was not surprising that conflicts of opinion should exist respecting the correct location of the boundaries in question, or that for many years the most learned constitutional advisers of the two Governments interested should be unable to effect an agreement.

It was held by the Government of Ontario on the one hand, that by the terms of the Treaty of Paris and subsequent acts and treaties, and having due regard to the Royal Proclamations which had been issued, and to the commissions given to the various Lieutenant Governors, and also to the fact that French settlements had existed far to the northwest, the western limits of the province of Ontario properly extended from the International Boundary to the southern limits of the territory granted to the Merchants Adventurers along the meridian line passing through the source of the Mississippi river; or, if these were not the western limits, that these limits should be farther to the west; and that if the northern limits of Ontario were not the southern limits of the territory granted to the Merchants Adventurers, then those limits were farther to the north.

It was held by the Dominion Government on the other hand that under the terms of the Quebec Act, subject to the limitations imposed by subsequent acts and treaties, the western limits of Ontario lay between the International Boundary and the southern boundary of the territory granted to the Merchants Adventurers, along the meridian line passing through the point of confluence of Ohio river with the east bank of the Mississippi; and that the northern boundary of Ontario was the height of land which divided the waters which flow towards Hudson bay from those which empty themselves into the valleys of the Great

Lakes. The word *northward* in the expression "northward to the southern boundary of the territory granted to the Merchants Adventurers" occurring in the Quebec Act, was by this definition interpreted as a due north line.

By the former definition the western limits of Ontario lay to the west of the Lake of the Woods, in approximate longitude 95° 14′, while by the latter these limits would pass close to Port Arthur in approximate longitude 89° 09′. The country between these two meridians, about 275 miles in width from east to west and extending from the International Boundary to the southern limits of the territory granted to the Merchants Adventurers, became known as "The Disputed Territory."

Original Boundaries of Manitoba

In the meantime by Dominion Act 33, Victoria, Chapter 3 (1870) the province of Manitoba had been created and its boundaries defined as the International Boundary on the south, the parallel of 50° 30′ north latitude on the north, and the 96th and 99th meridians of west longitude on the east and west respectively. (Successive extensions were made to the Province in 1881 and in 1912).

The Award

In 1878 in an endeavour to settle the question of the western and northern boundaries of Ontario, three arbitrators were chosen; one to represent Ontario (Hon. R. A. Harrison); one to represent the Dominion (Hon. Sir Francis Hincks); and by these two a third "not being a resident of Canada" was selected (Right Hon. Sir Edward Thornton, G.C.B., at that time Her Majesty's Minister at Washington).

The conclusion reached by these arbitrators became known as "The Award." The terms of The Award, which were satisfactory to the province of Ontario, were accepted by that province by 42 Victoria, Chapter 2, on March 11, 1879, but inasmuch as a select committee of the House of Commons reported that in their opinion The Award did not describe the true boundaries of Ontario, the legislation necessary to give binding effect was not passed by the Federal Government and The Award remained inoperative.

Extension of Manitoba's Boundaries, 1881

In December 1881 the Manitoba Legislature passed an act providing for an extension of that province. The provincial act was confirmed by the Parliament of Canada on March 21, 1881, by 44 Victoria, Chapter 14, and these became effective on and from July 1, 1881, by a proclamation of the Governor General issued June 13, 1881.

By these Acts the new boundaries of Manitoba became: on the south, the International Boundary; on the west, the centre of the road allowance between the twenty-ninth and thirtieth ranges west of the Principal meridian as sur-

veyed in the Dominion Lands Surveys system; on the north, the centre of the road allowance along the twelfth base line of the Dominion Lands Surveys system; on the east, the easterly limit of the District of Keewatin as defined by Dominion Act, 39 Victoria, Chapter 21, that is, the westerly boundary of the province of Ontario.

Ontario's Boundaries on the North and West Defined

As the addition thus granted to Manitoba overlapped a portion of the territory over which Ontario had for some time been exercising jurisdiction, some friction soon occurred between some of the Manitoba officials on the one hand and those of Ontario on the other, within the disputed area, and it was then finally agreed by all the Governments interested that the case should be submitted to the Judicial Committee of the Privy Council for a definite decision in order that the western and northern limits of Ontario should be finally determined.

The decisions of this Judicial Committee, according to the custom in such cases, were given in the form of a report to Her Majesty. The substance of the report was as follows:

1. "That legislation by the Dominion of Canada as well as by the province of Ontario was necessary to give binding effect as against the Dominion and the province, to The Award of August 3, 1878; and as no such legislation has taken place, The Award is not binding."

2. "That nevertheless their Lordships find so much of the boundary lines laid down by The Award, as relate to the territory now in dispute between the province of Ontario and the province of Manitoba to be substantially correct, and in accordance with the conclusion which their Lordships have drawn from the evidence laid before them."

3. (Definition of Boundaries).

4. "Their Lordships think it desirable and most expedient that an Imperial Act of Parliament should be passed to make this decision binding and effectual."

As recommended by the Judicial Committee, the boundaries of Ontario were defined in 1889 by Act of Imperial Parliament, 52 and 53 Victoria, Chapter 28, as follows:—

> "Commencing at the point where the International Boundary between the United States of America and Canada strikes the western shores of Lake Superior, thence westerly along the said boundary to the northwest angle of the Lake of the Woods, thence along a line drawn due north until it strikes the middle line of the course of the river discharging the waters of the lake called Lake Seul, or the Lonely Lake, whether above or below its confluence with the stream flowing from the Lake of the Woods towards Lake Winnipeg, and thence proceeding eastward from the point at which the before mentioned line strikes the middle line of the course of the river last aforesaid, along the middle line

of the course of the same river (whether called by the name of the English River or, as to the part below the confluence, by the name of the River Winnipeg) up to Lake Seul, or the Lonely Lake, and thence along the middle line of Lake Seul or Lonely Lake to the head of that lake, and thence by a straight line to the nearest point of the middle line of the waters of the Lake St. Joseph, and thence along that middle line until it reaches the foot or outlet of that lake, and thence along the middle line of the river by which the waters of Lake St. Joseph discharge themselves to the shore of the part of Hudson Bay commonly known as James Bay, and thence southeasterly, following upon the said shore to a point where a line drawn due north from the head of Lake Temiscamingue would strike it, and thence due south along the said line to the head of the said lake, and thence through the middle channel of the said lake into the Ottawa River, and thence descending along the middle of the main channel of the said river to the intersection by the prolongation of the western limits of the Seigneurie of Rigaud, such mid-channel being as indicated on a map of the Ottawa Ship Canal Survey made by Walter Shanly, C.E., and approved by Order of the Governor-General in Council, dated the twenty-first July, one thousand eight hundred and eighty-six; and thence southerly, following the said westerly boundary of the Seigneurie of Rigaud to the southwest angle of the said Seigneurie, and thence southerly along the western boundary of the augmentation of the township of Newton to the northwest angle of the Seigneurie of Longueuil, and thence southeasterly along the southwestern boundary of the said Seigneurie of New Longueuil to a stone boundary on the north bank of the Lake St. Francis, at the cove west of Point au Baudet, such line from the Ottawa river to Lake St. Joseph being as indicated on a plan of the line of boundary between Upper and Lower Canada made in accordance with the Act 23, Victoria, Chapter 21, and approved by Order of the Governor General in Council, dated 16th March, 1861."

Necessity for Surveys

It was pointed out by the Dominion Government in 1887, that "for judicial and other purposes it is very important that the portion of the Ontario-Manitoba boundary extending from the Northwest angle of Lake of the Woods to Winnipeg river should be defined at once," but no further steps were taken until 1893 when by Dominion Order in Council of October 28, P.C. No. 2823, the Provincial Governments of Ontario and Manitoba were invited to co-operate in the survey of the boundary from Lake of the Woods to Winnipeg river.

Manitoba, not being the owner of the timber, the minerals, or the public lands of the province, was not sufficiently interested in the survey of the boundary to warrant the incurring of any expense at that time for that purpose.

As the necessity for the survey was urgent it was agreed between the Ontario and Dominion Governments in 1897 to proceed with the survey, each paying one-half the cost. B. J. Saunders, O.L.S., was appointed Commissioner for Ontario, and Elihu Stewart, D.L.S., was appointed to represent the Dominion, and these two, by a joint survey 1897-8 marked the boundary line from the northwest angle of Lake of the Woods to Winnipeg river.

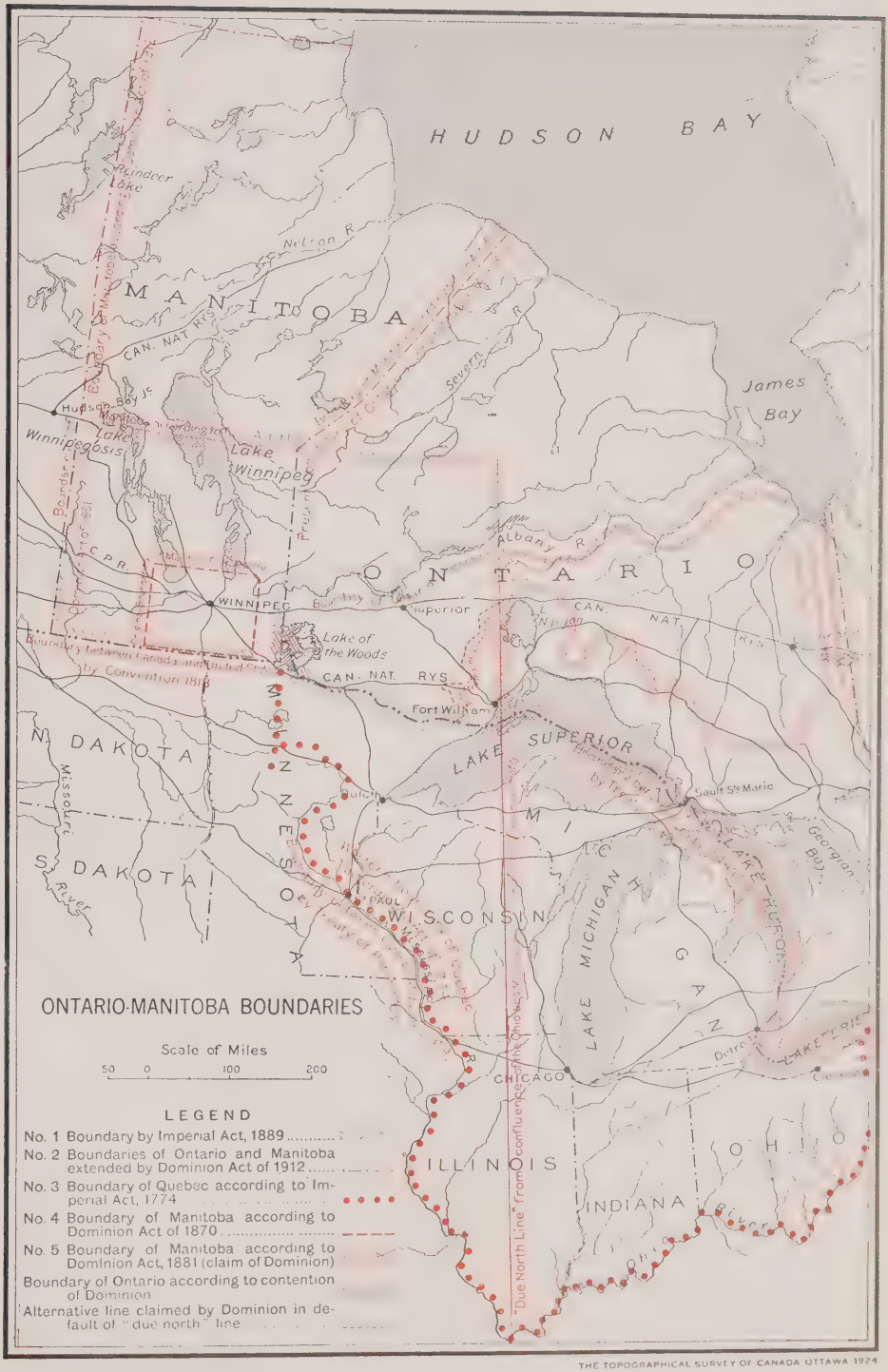
When the survey had been concluded, the question of the necessity for any further steps being taken in order to confirm the boundary line as surveyed by the Commissioners was submitted to the Deputy Minister of Justice, who in reply gave his opinion "that the boundary line as marked on the ground by Messrs. Stewart and Saunders can be absolutely established only by legislation. If the Legislatures of Ontario and Manitoba consent, the Parliament of Canada can by virtue of the provisions of the British North America Act, 1871, pass an Act declaring that line to be the boundary line between the two provinces. Orders in Council of the several Governments accepting the line might be passed but these would not bind the Provincial Legislatures or the Parliament of Canada."

By Dominion Order in Council of 10th October, 1898, P.C. 2247, the provinces of Ontario and Manitoba were invited to accept the boundary as marked on the ground by Commissioners Saunders and Stewart.

Ontario accepted by 62 Victoria, Chapter 2, which enacted as follows:—

> "1. In case the Legislature of the Province of Manitoba consents thereto the Legislature of the Province of Ontario hereby consents that the Parliament of Canada may declare that the boundary line marked and laid down by the said Commissioners and described in the Schedule to this Act shall be the boundary line between this Province and the province of Manitoba, although the limits of the province may be thereby increased or diminished or otherwise altered."

It does not appear that Manitoba has, by any Legislative Act, accepted the survey of the boundaries as laid down on the ground by the commissioners appointed by the Ontario and Dominion Governments, and as such consent is required before these boundaries can be established by the Federal Government, the survey of the boundary has not yet been confirmed.



THE TOPOGRAPHICAL SURVEY OF CANADA OTTAWA 1924

ONTARIO-MANITOBA BOUNDARIES

CHAPTER II

PRESENT BOUNDARIES

Present Boundaries of Ontario on the North and West

In 1912, the Ontario Boundaries Extension Act, 2 George V., Chapter 40, accepted by the province, and becoming effective on and after 15th May, 1912, by Proclamation of 10th May, 1912, enacted as follows:—

2. "The limits of the province of Ontario are hereby increased so that the boundaries thereof shall include, in addition to the present territory of the said province, the territory bounded and described as follows:—Commencing at the most northerly point of the westerly boundary of the province of Ontario as determined by 'The Canada (Ontario Boundary) Act, 1889,' chapter 28 of the statutes of 1889 of the United Kingdom, (the said westerly boundary being the easterly boundary of the province of Manitoba); thence continuing due north along the same meridian to the intersection thereof with the centre of the road allowance on the twelfth base line of the system of Dominion Land Surveys; thence northeasterly in a right line to the most eastern point of Island lake, as shown in approximate latitude 53° 30′ and longitude 93° 40′ on the railway map of the Dominion of Canada, published, on the scale of thirty-five miles to one inch, in the year one thousand nine hundred and eight, by the authority of the Minister of the Interior; thence northeasterly in a right line to the point where the eighty-ninth meridian of west longitude intersects the southern shore of Hudson bay; thence easterly and southerly following the shore of the said bay to the point where the northerly boundary of the province of Ontario as established under the said Act intersects the shore of James bay; thence westward along the said boundary as established by the said Act to the place of commencement; and all the land embraced by the said description shall, from and after the commencement of this Act, be added to the province of Ontario, and shall, from and after the said commencement, form and be part of the said province of Ontario . . . . . ."

Present Boundaries of Manitoba

In 1912, by the Manitoba Extension Act, 2 George V., Chapter 32, assented to by the province, and effective on and after 15th May, 1912, by Proclamation of May 10, 1912, the boundaries of that province became extended by clause 3 as follows:—

"3. The limits of the province are hereby increased so that the boundaries of the province shall be as follows:—Commencing where the sixtieth parallel of

north latitude intersects the western shore of Hudson Bay; thence westerly along the said parallel of latitude to the northeast corner of the province of Saskatchewan; thence southerly along the easterly boundary of the province of Saskatchewan to the international boundary dividing Canada from the United States; thence easterly along the said international boundary to the point where the said international boundary turns due north; thence north along the said international boundary to the most northerly point thereof at or near the north-west angle of the Lake of the Woods; thence continuing due north along the westerly boundary of the province of Ontario, by virtue of 'The Canada (Ontario Boundary) Act, 1889,' chapter 28 of the statutes of 1889 of the United Kingdom, (the said westerly boundary being the easterly boundary of the province of Manitoba) to the most northerly point of the said boundary common to the two provinces under the said Act; thence continuing due north along the same meridian to the intersection thereof with the centre of the road allowance on the twelfth base line of the system of Dominion Land Surveys; thence north-easterly in a right line to the most eastern point of Island Lake, as shown in approximate latitude 53° 30′ and longitude 93° 40′ on the railway map of the Dominion of Canada published, on the scale of thirty-five miles to one inch, in the year one thousand nine hundred and eight, by the authority of the Minister of the Interior; thence north-easterly in a right line to the point where the eighty-ninth meridian of west longitude intersects the southern shore of Hudson Bay; thence westerly and northerly following the shores of the said Bay to the place of commencement; and all the land embraced by the said description not now within the province of Manitoba, shall, from and after the commencement of this Act, be added thereto and the whole shall, from and after the said commencement, form and be the province of Manitoba."

Necessity for Surveys of a Portion of the Extended Boundaries

The necessity for marking on the ground the extension of the boundaries between Ontario and Manitoba, became the subject of correspondence between the Governments of Ontario, Manitoba and the Dominion during 1913 and 1914. The Governments of Manitoba and Ontario made formal request to the Federal Government that this boundary should be surveyed by the Department of the Interior at the expense of the Federal Government. This proposition was not favourably entertained by the Federal Government and the matter of further surveys was left in abeyance for the time.

In 1920, H. G. Beresford, Dominion Land Surveyor, who for several years had been surveying mineral claims in the Rice Lake district in Manitoba reported that claims were being staked near the boundary between Ontario and Manitoba, and called attention to the necessity for an early demarcation of the boundary line from Winnipeg river northerly through the mining district.

As the question of the boundary survey had now reached a stage where further delay would probably be followed by serious complications, and as the

Surveyor General of Dominion Lands and the Director of Surveys of Ontario were agreed as to the necessity of the survey being made through the mining district, these facts were by them reported to their respective Governments and proposals were submitted at the same time indicating the preliminary steps which should be taken.

In the preliminary correspondence between the Surveyor General and the Director of Surveys, it had been agreed that a large item in the expenditure in such surveys as the one now under consideration was the salaries of the Commissioners. That while it is very necessary in an ordinary boundary survey that each Government should be represented by a special Commissioner devoting the whole of his time to the protection of the interests entrusted to him, there was little occasion in the present case for any difference of opinion as to where the boundary ought to be. According to definition by the Act the boundary as far north as the twelfth base line of the Dominion Lands Surveys system is a due north line, and its location at any point is therefore not open to discussion. It was therefore agreed that they should recommend to their respective Governments that the commissioners appointed should be the Surveyor General of Dominion Lands for the Dominion Government, and the Director of Surveys for the Ontario Government, and that these should then select a surveyor, mutually satisfactory, to survey and mark the line. This arrangement would not only effect a great saving in expenditure as the salary of one surveyor only would be incurred instead of the salaries of two commissioners, but would also avoid dual control of the survey party, which has usually proved an unsatisfactory arrangement.

These suggestions received the approval of the Ontario and Dominion Governments, and by Ontario Order in Council of 9th February, 1921, and Dominion Order in Council of 26th February, 1921, the Director of Surveys of Ontario, and the Surveyor General of Dominion Lands were appointed Commissioners by their respective Governments, and were authorized to take the necessary steps for proceeding with the survey of the boundary northerly from Winnipeg river.

Copy of an Order in Council approved by His Honour the Lieutenant Governor dated the 9th day of February, A.D. 1921:—

EXECUTIVE COUNCIL OFFICE

The Committee of Council have had under consideration the report of the Hon. the Minister of Lands and Forests dated 7th February, 1921, wherein he states that by the Ontario Boundaries Extension Act, 2 Geo. V., Chap. 40, (Dominion Statutes) there was added to the Province of Ontario a territory bounded on the west and northwest by a due north line from the most northerly point of the western boundary of Ontario to the centre of the road allowance on the twelfth base line of the system of Dominion Land Surveys, thence to the most eastern point of Island lake, thence northeasterly in a right line to the intersection of the southern shore of Hudson bay by the eighty-ninth meridian of west longitude. It is submitted that considerable mining development is now taking place in close proximity to the said boundary and that its definition by survey on the ground has become necessary.

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The Minister recommends that in the event of the province of Manitoba declining to join in the survey and to pay one-third of the expenditure that the survey shall be proceeded with by Ontario and the Dominion each paying one-half of the expenditure.

The Minister further recommends that the Director of Surveys for Ontario be appointed Interprovincial Boundary Commissioner to represent the province of Ontario upon the said survey and that the Commissioners when appointed be authorized to take the necessary steps for proceeding with such survey.

The Committee concur in the recommendation of the Hon. the Minister and advise that the same be acted on.

Certified "C. F. BULMER,"
Clerk, Executive Council.

Certified copy of a Report of the Committee of the Privy Council, approved by His Excellency the Governor General on the 26th February, 1921:—

P.C. 546

The Committee of the Privy Council have had before them a Report, dated 9th February, 1921, from the Minister of the Interior, submitting that by the Ontario Boundaries Extension Act, 2 George V, Chapter 40, there was added to the province of Ontario a territory bounded on the west and northwest by a due north line from the most northerly point of the westerly boundary of Ontario to the centre of the road allowance on the twelfth base line of the system of Dominion Land Surveys; thence to the most eastern point of Island lake; thence northeasterly in a right line to the intersection of the southern shore of Hudson bay by the eighty-ninth meridian of west longitude.

The Minister states that considerable mining development is now taking place in close proximity to the said boundary and that its definition by survey on the ground has become necessary.

The Minister therefore recommends as follows:

That the provinces of Ontario and Manitoba be invited to appoint Commissioners for making the survey, each province to pay one-third of the expenditure and that the remaining third of the expenditure be paid by the Dominion.

That in the event of the province of Manitoba declining to join in the survey and to pay one-third of the expenditure, the survey shall be proceeded with by Ontario and the Dominion, each paying one-half of the expenditure;

That the Surveyor General of Dominion Lands be appointed Interprovincial Boundary Commissioner to represent the Dominion upon the said survey and the Commissioners when appointed be authorized to take the necessary steps for proceeding with the survey.

The Committee, concurring, advise that a copy of this Minute be transmitted to the Lieutenant Governors of Ontario and Manitoba, for the information of their Governments.

All of which is respectfully submitted for approval.

(Sgd.) G. G. KEZAR,
Asst. Clerk of the Privy Council.

The Honourable,
The Minister of the Interior.

Selection of Surveyor

It was necessary that the surveyor selected to carry out the survey on the ground should be properly qualified both as a Dominion and as an Ontario Land Surveyor, and it was considered advisable that he should be assisted by

two qualified surveyors. Mr. J. W. Pierce, Dominion and Ontario Land Surveyor, was selected as Chief of Party, with Messrs. R. D. Davidson and J. Carroll as first and second assistants respectively.

Instructions for the Survey

A brief summary of the instructions issued by the Commissioners to the surveyor in charge of the survey is as follows:—

1. The line to be surveyed is the meridian boundary from Winnipeg river to the twelfth base line of the Dominion Lands Surveys system. The instructions herewith apply only to this portion of the boundary.

2. The survey will be commenced at the most northerly monument found in good condition, established on the south side of Winnipeg river by the Joint Commission of 1897.

The direction of the meridian shall first be ascertained by a series of astronomical observations and the boundary line thereafter continued as a due north line on which permanent monuments shall be established to mark the boundary.

The production of the boundary line and the astronomical work shall be carefully carried out according to the method prescribed in the Manual of Surveys for the survey of governing lines of the Dominion Lands Surveys system, using a six-inch micrometer block survey reiterating transit which has previously been tested at the Surveys Laboratory.

Astronomical observations for azimuth are to be taken frequently enough to ensure accurate maintenance of the correct direction of the boundary line.

Two independent measurements of distance between monuments shall be made, using two steel tapes which have been tested at the Surveys Laboratory. In making the measurements every possible care shall be taken to ensure the highest degree of accuracy consistent with the nature and requirements of the survey and standard tests should be applied to the chainers' work to ensure that the required accuracy is being maintained.

3. For the purpose of marking the boundary two forms of monuments shall be used.

(*a*) Solid monuments of concrete are to be erected along the boundary at intervals of approximately six miles. These shall be similar in form and dimensions to those erected on the survey of Alberta-British Columbia interprovincial boundary and shall bear brass plates carrying the inscription "Manitoba" on one side and "Ontario" on the other.

(*b*) Special iron posts with bronze caps, of a type similar to that of the standard posts used on Dominion Lands Surveys are to be planted in the ground or cemented in the rock as circumstances require at suitable points along the boundary line not more than 100 chains apart.

The first monument established north of Winnipeg river is to be marked with the number 83 and the monuments established thereafter as the line is

produced northward are to be numbered consecutively irrespective of whether they are concrete monuments or special iron posts.

At the sites of the special posts, pits are to be dug and mounds of earth or stone erected similar to those on Dominion Lands Surveys.

Special care should be exercised in the selection of suitable sites for the monuments having regard to permanence of foundation, accessibility, and the readiness with which they may be located. Consecutive monuments should be intervisible wherever possible. Photographs should be taken of the concrete monuments and prints of the caps of the special posts.

4. Observations for magnetic declination are to be taken as frequently as possible.

5. A line of levels should be carried along the boundary in accordance with the methods used in levelling along the base lines and meridians of the Dominion Lands Surveys system.

6. Topographical details are required for one mile on each side of the boundary line and all information of importance respecting the natural resources of the country through which the line passes is to be collected and reported upon. The classes of soils and subsoils are to be recorded, together with their depths, and representative samples taken for analysis. Notes should be recorded respecting forest cover, timber and pulpwoods, water powers, water routes, storage areas, agricultural areas, economic minerals, game, fish, and climatic and meteorological conditions.

7. The final returns of the survey shall consist of: plan, field notes, general report, azimuth observations, magnetic observations, level returns, oaths of chainmen, and accounts and vouchers.

CHAPTER III

METHODS OF SURVEY

Organization of Party

It was recognized that the execution of a survey of the standard required for an Interprovincial Boundary, in the district through which these operations were to be carried, presented some problems not usually encountered in ordinary surveys. The two outstanding features were the necessity for a high degree of precision in all details of the survey, and the obstacles occasioned by a lack of convenient transport routes along the line. While neither one of these alone would have presented more than the ordinary difficulties which surveyors meet with every day, a combination of these two necessitated the employment of a larger party than is usual on ordinary surveys, and for a somewhat longer period.

As it was necessary both to maintain the required standard of survey, and to extend the line through a country presenting unusual transportation difficulties it was important to carefully study and become familiar with all the district had to offer in the way of possible routes, and then to organize a suitable field party, properly equipped so as to make the best possible progress. The personnel, duties, and most effective allotment of a party of 24 selected for survey were as follows:

Personnel	Duty
1. The surveyor	Direction and general supervision of work in the field.
2. The first assistant, a qualified surveyor	Line production, azimuth and magnetic observations, triangulations, and other related work.
3. The second assistant, a qualified surveyor, with one chainman	Precise chaining, check chaining, observing and recording of topographical data along the line, and marking of monuments.
4. The third assistant, a qualified leveller, and one rodman	Levelling and check levelling, locating and recording permanent bench-marks.
5. The fourth assistant, a competent instrument man, accompanied by two rodmen	Stadia surveys of water areas, field plotting of traverses, and collection of topographical information away from the line.
6. The mounder, assisted when necessary by axemen from the linemen	Monument construction, including the collection and assembly on the ground of the necessary gravel and cement required for construction, the erection of stone mounds, and setting of rock posts.

7. One picketman, assisted by seven axemen....Clearing out the main line, the offsets, and triangulation bases, and the setting of transit stations and line pickets.
8. One head packer and three canoemen and packers, these being assisted when necessary by other members of the party.....Transport, including the forwarding of supplies, equipment, and cement from caches to where they are required along the line, the moving of camp and the exploration for, the location of, and the clearing out of the necessary canoe routes and portages.
9. One cook and one second cook.....Preparation and serving of meals, guarding and caring for provisions and stores in camp and cutting fuel.

As indicated by the foregoing statement, the duties of some of the members of the party were interchanged when need arose, in order to prevent any detail lagging behind that of the general progress of the survey. Work of this nature demands a class of men that is yearly becoming harder to procure. It is essential that the men employed be familiar with the use of a canoe and the portage strap; they must be good axemen; they should be willing to separate themselves from their families for an entire field season; they must content themselves with living through the season on provisions that have been stored in caches the previous winter; and it is advisable that they have previous survey experience. The natives of the district are, on account of their experience in the country and their intimate knowledge of its geography, the most suitable for survey requirements, if they could be induced to stay on the work for any length of time. This they will not do. There are yet, in this and in adjoining districts, many desirable white men, but usually they are not now procurable at the rate of pay prevailing on survey parties.

Line Production

The production of the line consisted of two separate operations, each serving as a check on the other. This method of checking was employed, not only in line production, but was extended through all the essential operations of the survey. Observations for azimuth were made in sets of three and magnetic observations in sets of five; measurements of distance along the line were the result of two separate measurements made with chains of different units of length; distances measured across water were the mean determination of two distinct triangles; while elevations of monuments, bench-marks, and natural features were obtained by two separate lines of levels.

The operation of line production was accomplished by the use of two transits, that used for the final alignment and azimuth observations being a 6-inch reiterating transit of the block survey type, commonly known as a base line transit, while for the preliminary line, measurement of triangles and magnetic observations, a 5-inch Cooke transit of the D.L.S. pattern was used.

The first step in the operation of producing the boundary after the line had been cleared was to extend the preliminary line with the Cooke transit. This served to keep the opening centred along the true line. As lakes or other obstacles were encountered, requiring a triangulation, the instrumental work in connection with the laying out of the triangles and the measurement of their angles, was at once completed and the necessary data given to the chainman. As the line passed over a commanding point suitable for the location of a monu-

TIMBER NORTH OF BRADBURN LAKE
View south from Monument No. 185 near Mile 196 showing stand of jackpine and spruce.

TYPICAL OPENING ON THE BOUNDARY LINE
Looking across Bradburn lake, near Mile 193, with concrete monument, transit station platform and line picket in the foreground.

ment or a transit station of the final line, the approximate position of this point was defined by the Cooke transit. This enabled the monument builder to commence collecting the required material for the construction of the monument.

When the preliminary line reached a suitable point for the location of a transit station on the final line, the first assistant returned to the base line transit. This was usually a mile or so back, and sometimes as far back as three

miles on occasions when unsuitable lighting conditions or cloudy weather prevented the taking of azimuth observations, and the production of the final line. In the meantime, the picketman had prepared a stationary platform visible from the base line transit on which to receive the points thrown from the preceding station. By means of the small transit he was able to read the signals given from the base line transit and to record on the platform a series of eight points marking the circle right and circle left positions of the cross wire. In this operation, it was preferable that the picketman be accompanied by another helper, although this was not essential. Usually, however, the levellers or chainmen were available at this time.

The successful production of the final line required, in addition to care and accuracy on the part of the instrument man, a clear steady light of high visibility. On this account it was often, particularly in midsummer, not possible to set the forward station during working hours, unless clouds intervened to protect the operation from the heat of the sun. It frequently had to be done during the morning or evening.

The relative positions of the points on the platform bear a distinct relation to the accuracy with which the production has been made. Theoretically, the four odd numbered points should be identical, as should the four even numbered points. The distance between the odd and even numbered points, corresponding to the circle right and circle left positions of the cross wires, should bear a fixed ratio to the length of the sight and the collimation error. Preliminary to occupying the new station, the relation of these points was carefully measured and weighted by the instrumentman, and the position of the final point over which the instrument would be placed was determined. If an observation for azimuth was not required or possible, the line was final thus far, and monuments were aligned between this and the preceding station.

AZIMUTH OBSERVATIONS

A series of observations for azimuth was taken at regular intervals along the entire line, these all being made with the base line transit reading to five seconds, but which may be estimated to single seconds. In all, a total of 186 observations was made, and these when possible were taken in sets of three at each station and the resulting error of the mean azimuth should not exceed 10″. Immediately following or prior to the azimuth observation, an observation for time was made, but where this was not possible on account of obscured sky, the sidereal time was obtained from observation on the sun and the chronometer corrected by interpolation. The average distance between observation stations was about two miles. Where the observations showed that the line was diverting more than the probable amount of the error of observation, it was corrected by offsetting. The maximum variation of azimuth as shown by observation along the line is at one point about 10″, due to a protracted period of unsatisfactory weather conditions which would have

caused serious delay to the survey if monument construction and final alignment had awaited more satisfactory azimuth results. The usual variation is from 1″ to 3″, seldom over 5″, but as the probable error of any azimuth observation may be 10″, all this is well within the limit of accuracy attainable on work of this nature.

LINE CLEARING

The line was opened out so that a clear skyline 6 feet in width was maintained throughout. To obtain a skyline six feet in width necessitated clearing

CLEARING NECESSARY THROUGH VARIOUS TYPES OF TIMBER

The line through scanty timber, characteristic of many of the uplands.

The line through heavy timber north of Snowshoe lake.

a much wider space at the ground especially through heavy timber and this often required the felling of trees for 12 or 15 feet from the centre of the line. Care was taken throughout, to keep this opening properly balanced on each side of the line and to remove all high logs or débris from its centre so as to render the surface as suitable as possible for careful measuring and instrumental

work. Suitable healthy trees adjoining the opening were blazed on three sides in the manner customary on both Dominion and Ontario Land surveys.

The labour of clearing the line necessitated a party of seven axemen under the immediate direction of a picketman. As the progress of the whole survey is, to a great extent, dependent upon the rapidity with which the line is cleared, particular attention was paid to the selection of these men and later, when in the field, to remove any cause that would prevent their continuous performance. Aside from interruption due to transportation problems, the rate of progress varied greatly with changes in the character of the forest cover. At the commencement of the work in the vicinity of Winnipeg river, again to the north of Snowshoe lake, and in fact, usually wherever the line crossed the main water-

Clearing Necessary Through Various Types of Timber
Opening through burnt timber near the Twelfth Base Line

courses, such as the Wanipigow, Manigotagan and Bloodvein, but excepting the Berens river, continuous heavy timber was encountered. Here daily progress with a full party would often drop to 40 chains. As the heights of land were approached, the timber was usually lighter, and was often only scrubby jackpine on the summits with spruce swamps elsewhere, when a day's progress would occasionally reach one and one-half miles. A very considerable portion of the line was opened through burned over areas. Some of these were burned so clean that scarcely any labour was necessary, as for example, the country immediately to the south of Snowshoe lake and to the north of Moar lake. In other places, the timber had not been burned so completely and the surface was a litter of fallen and turned over timber filled with a dense growth of small jack-

pine and spruce. This, coupled with the roughness of the surface, presented great obstacles to the clearing of the line. Notwithstanding the difficulties in clearing the line, the daily progress, where there was no interruption to the work was roughly a mile a day.

The net result of these operations is that this line is so opened out that it is readily located, either from the ground or from the air and as long as the present timber remains, it will always be easily found.

MEASUREMENTS

The primary object of the measurements made was to determine the actual distances between the permanent monuments and to locate the intervening topographical data. The surveyed line, in addition to defining the boundary, thus serves as a base or control from which secondary surveys may be extended as required. Measurements were started from the old iron and wooden posts, found in bad condition and replaced by a standard cement monument, marking the termination of that portion of the Ontario-Manitoba boundary surveyed in 1897, on the south side of Winnipeg river, at 58 miles and 27·20 chains north of the Northwest Point*. This mileage was accepted by the present survey and continued to the termination of the Meridian line at 238 miles and 13·28 chains, being the middle of the road allowance at the twelfth base line. Two independent sets of measurements were made along the line for this purpose, the primary or main chainage, hereinafter described, followed by the check chainage, the latter being more rapidly executed and intended only as a protection against error.

In the main chainage, a 400 link $\frac{1}{8}$-inch steel chain was suspended between two tripods under a uniform tension. On one of the tripods a transit was mounted for purposes of alignment and in order to determine the amount of slope of the chain. The chain was read at the rear tripod, its temperature observed at each set up by means of suitable thermometers, and having determined the slope to the forward tripod, the true distance between the tripods was then deduced in terms of the chain used. As a safeguard against the chain varying in length during its continued use in the field, a similar chain whose actual length under the same tension had previously been determined at the Surveys Laboratory of the Department of the Interior, was taken to the field as a standard and was at intervals compared with the field chain. From this comparison, a varying correction was deduced and applied to the main chainage in order to obtain its correct length.

The apparatus used at the commencement of the survey was what had previously been used on some base line surveys. This, in addition to the tripods, included a device for anchoring to the ground one end of the chain, which had previously been lengthened for that purpose. At the other end, a spring balance was attached to the chain, while a straining bar was connected with the balance. The tension was applied to the chain by means of leverage from the straining bar, its amount being determined by the spring balance. In its original form

* The most northerly point in the International Boundary at the Northwest Angle of the Lake of the Woods, established by Dr. I. L. Tiarks and David Thompson, and confirmed by The Ashburton Treaty in 1842. The present location of this point, as defined by Treaty in 1925 is 72·5 chains due south of its original position.

this apparatus required a third man to handle it properly. It was also found difficult to anchor it on surfaces of rock, and as a considerable portion of the line lay in rocky country, this proved a drawback.

Prior to the commencement of operations in 1922, some modifications to this apparatus were devised in order to make it more suitable for use in this particular district, and incidentally these improvements permitted of the operation being carried on by two men instead of three. The modifications included

FRONT TRIPOD, CHAINAGE APPARATUS

Showing chain passing over ball-bearing pulley, with weight and thermometer in position. The plumb-bob is suspended from a block that is moved along the horizontal arm until it is coincident with the zero mark of the chain.

the use of a 30-pound weight that was attached to each end of the chain by means of piano wire. This prevented the necessity of anchoring the chain to the ground and permitted a much wider range in setting up the apparatus. Setting up at the water's edge or on the brow of a precipice now offered no difficulty. One leg of each tripod was lengthened so as to prevent any tendency of the apparatus toppling over when the weights were attached to the chain.

The forward tripod was fitted with a Hoffman head that allowed the necessary adjustment for alignment and levelling and to this was attached a frictionless bearing pulley over which the chain passed from the weight. For convenience in referencing the zero mark of the chain to the ground, an arm extended from the Hoffman head, which when the head was adjusted, passed directly under the chain. On this arm was a movable block from which the plumb-bob was

Rear Tripod, Chainage Apparatus

Showing chain passing through centre of transit with weight and thermometer in position. By means of the plumb-bob, the transit is centred over the point from which the measurement is to be made.

suspended. A target at the same height above the chain as the axis of the telescope on the rear tripod, was connected to the head for the accurate reading of the slope.

In operation, the forward tripod was set up on line slightly in advance of where it was desired to measure to, the chain passed over the pulley, and the weight attached. By means of the Hoffman head, the pulley and block supporting the plumb-bob were adjusted to their proper relation with the chain. The

point to be measured to was then marked on the ground and the plumb-bob centred over it. The chain was moved forward (never backward) until the zero graduation was coincident with the mark on the block and this exactly over the point.

The only alteration to the rear tripod on which the transit was mounted on a Hoffman head, was the attachment of a roller on an arm extending from the spindle of the transit which permitted the chain to pass between the standards clear of the plates. The weight here acted merely as an anchor and it was not necessary to introduce a frictionless pulley. It was recognized that the levelling screws of a transit were never intended to support a 30-pound weight but in this case, the apparatus had already greatly deteriorated as a transit, due to its previous use, and it was the only instrument available that could readily be

Chainmen Carrying Chainage Apparatus

adapted to meet the requirements. In the field, this apparatus was set over the point on the ground by plumb-bob in the usual manner, the chain passed between the standards, and the weight suspended. Everything being set at the forward end, the observer, by means of a scale graduated to hundredths of links, read the distance on the chain to the centre of the transit.

Special trough thermometers with a broad flat bulb, so arranged that the chain is held in intimate metallic contact with the bulb, were designed by the Taylor Instrument Companies, at the suggestion of the Surveys Laboratory of the Department of the Interior. These were used to great advantage for the determination of the temperature of the chain.

This apparatus, consisting of two tripods and two 30-pound weights, besides the chain, axe, note books, and other utensils will not bear favourable comparison with the ordinary chainage outfit, in point of portability. It was, however, transported by the two chainmen throughout the season, who handled all details regarding both final and check chaining and kept up with the general progress of a survey, which averaged a mile a day.

The chief advantage of this method of chaining is the opportunity it affords for measurements of considerable precision. Error due to actual length, inequality of tension, slope, and temperature are to a great degree determined and corrected and at no delay to the general progress of the remaining operations of the survey. It would not be possible, however, to materially increase the distance measured in this manner in a season beyond what was accomplished. Consequently, the method would not be suitable for indiscriminate use in districts permitting of more rapid line production. Then, it might not be used effectively in more open country on account of the action of the wind on the chain when suspended.

The positions of all monuments, bench-marks, transit stations, traverse hubs, triangulation points, and natural features were carefully noted during the chaining and entered in the field notes. Topographical features such as summits, depressions, water, timber distribution, swamps, and other items of note, were sketched and described in the notes as far as they could be observed from the line.

As operations were carried on during the summer season only and the line frequently crossed water areas, the determination of distances by means of triangles was a continually recurring task. The principle followed was to lay out two triangles each with the apex angle at least 30° and the other angle on the line as near 60° as possible. In order to avoid as far as possible, unnecessary labour, the triangle bases were opened out sufficiently wide to permit of both bases being in the same opening. The lengths of the two bases were measured by the tripod method and checked by a 300-foot chain. All the angles in each triangle were measured by reiteration eight times with the Cooke transit, after which the angles of each triangle were balanced. Both triangles were then calculated and the mean result was used for the distance required. These reductions and calculations were in all cases immediately checked in the field by independent calculations. On account of the irregular nature of the shore line of water areas in this district, in addition to the roughness of the surface, the location of the desired triangles usually caused more delay than any gain in time derived from the line crossing water. Trial lines for bases were frequently run and re-run before a suitable base could be located and often a great part of the third side of the triangle was on land, necessitating clearing on that side also. The object was to lay out a triangle having suitable angles and so that each apex would be visible from the others.

MONUMENTING

The erection of monuments formed one of the most important of the many duties relating to the survey. It was essential that these marks be of as permanent and indestructible a nature as possible so as to prevent any necessity of their renewal for a great many years to come. These, in addition to the cut line, constitute the only visible evidence of the boundary on the ground and are the basic points to which all other features of the survey, such as topography, relief, and azimuth, are referred. Particular care was taken in the selection of the monument builder, not so much in regard to his ability, as to his dependability, and to impress him with the importance of this duty and the necessity that this work be made permanent as well as of pleasing appearance. Before leaving the field, all monuments constructed were examined by members of the staff in order to prevent the possibility of any of them being imperfect.

The general regulations regarding monumenting were that they be placed at average distances of 100 chains apart and that suitable sites should be selected having regard to permanence of foundation, accessibility, and convenience of location. They should also be as far as possible intervisible. In the field an unexpected condition was found to obtain throughout the entire survey in that the summits where monuments were located consisted of bare bed rock. This offered unusual opportunity for the erection of monuments of great permanence. It also resulted in a saving of upwards of three-quarters of the cement and material that would have been necessary if footings extending below the frost line had been required.

The selection of suitable sites with regard to intervisibility occasionally presented some difficulty. On account of the importance of completing all details of the survey as the work progressed, so that all members of the party returned to the same camp at night, where their progress was reported and operations for the following day planned, and to enable personal inspection and photographing where necessary of completed work, it was an economic advisability that monument sites should be decided on as soon as possible. This permitted of the assembly of the material on the ground, the erection of the monument and (after allowing it to set) the removal of the forms, the determination of its precise elevation and actual location, and finally its being photographed, all without unnecessary delay to the general progress of the survey. As the line was opened further it was noticed, however, on two occasions, that a more desirable site in regard to intervisibility was obtainable, if the selection had been delayed. While all monuments are visible from at least one monument, and are, with the exceptions noted, intervisible, it was considered that if the monumenting was held up pending the selection of a more suitable site, the resulting delay to the general progress would be more serious than the advantage to be gained.

Two main types of monuments were used throughout the work: (1) Concrete monoliths and (2) Special posts and stone mounds, or mounds and pits as

the case would require. The concrete monoliths were erected at points approximately six miles apart and were as far as possible placed on the most commanding elevations along the line that the district afforded. These monuments being more distinctive than the special posts, were also placed in convenient proximity to the crossings of the main water routes, these being the usual points of approach by those having occasion to investigate the line. In all, 30 of these concrete monoliths and 108 special posts with their accompanying mounds were erected.

The concrete monolith consists of a pyramidal shaft 20 inches high, 12 inches square at the base, and 7 inches square at the top, set on a concrete base 24 inches square. The base, in all cases, rests on solid bed rock which has previously been roughened or broken, if necessary, so as to furnish a suitable surface for

TYPES OF CONCRETE MONUMENTS ERECTED

Monument used during 1921 Monument used during 1922

bonding with the concrete. The top of the pyramid was, during the first year's operations, left nearly flat; the appearance of those built during the second season was greatly improved by the use of an auxiliary form that permitted the top to be extended as a more acute pyramid, terminated by the standard bronze rock post, on which was the centre mark, and the monument and bench-mark numbers. Suitable hardwood forms, made so that they could be taken down for portability, were used in the construction of the monoliths. This resulted in all monuments being uniform in dimensions and appearance.

Brass plates about $\frac{1}{8}$-inch thick, engraved and enamelled with the name and crest of the province, and the letters "No." with space left for the addition in the field of the numerals, were attached to the proper sides of each monolith by means of five threaded brass bolts, each $\frac{1}{4}$-inch in diameter and $3\frac{1}{2}$ inches long.

On each bolt were two nuts that were placed at intervals and allowed to become imbedded in the concrete to act as an anchor. To insure the plates retaining their proper position on the monolith while the concrete was setting, they were temporarily attached to the forms by means of two small stove bolts. These were readily removed before the forms were taken off without causing any disturbance to the plates.

All monuments, whether concrete monoliths or special posts, were numbered consecutively as they were built in the field. This required the addition of the distinctive numbers to the brass plates on the concrete monoliths. An ingenious device which had previously been used for this purpose on the International Boundary was adapted to the present requirements. This consisted of a set of number templates with the necessary blank blocks, and a jig by which they were held in position on the plate to be marked and a hand drill. By this method, the number was indicated by a succession of dots, $\frac{5}{32}$-inch in diameter, bored into the plate. In the construction of the monument one bag of cement weighing 90 pounds was mixed with twice that quantity of sand and an equal volume of gravel or broken stone in the preparation of the concrete. This mixture is somewhat richer in cement than what is ordinarily used on standard concrete construction work, where the mixture while setting is protected from adverse weather. After pouring, the concrete was carefully tamped to render the mass solid and compact and at least 24 hours elapsed before the forms were removed. As sand and rock for preparing broken stone were usually readily procurable when required, the chief expense in building monuments of this nature was in the cost of the transportation of the cement required, the brass plates, and the labour in construction.

For operations of the first season, cement sacked in waterproof bags was placed on the ground before the commencement of the survey. Although this was further carefully protected from water and rain through the season by additional waterproof canvas and tarpaulins, yet the cement absorbed sufficient dampness from the air to impair its quality and towards the fall, less than one-half of it could be used. The fact that these monuments were located on solid rock, where no footings were required, thus reducing the expected quantity of cement necessary for construction, proved extremely fortunate. The method of packing the cement used during the second season was much improved by having it all put up in sealed galvanized iron containers before shipment. This not only made it more convenient for transportation in the field but it effectively preserved it from dampness.

A standard rock post was placed in the top of the monolith to indicate its centre point and this was aligned and tied to the main chainage. During the latter portion of the survey there was an over supply on the ground of the standard post 30 inches long, due to the fact that very few were used. These were cut off to 24 inches in length and were used instead of the rock post for the centre mark of the monolith, thus permitting of the monolith being reinforced by a 24-inch iron tube, itself filled with cement. For purposes of record, all these monuments were photographed after they were built.

Two types of secondary monuments were used: (1) A standard rock post cemented in the rock and stone mound. (2) A standard post 30 inches long placed in the ground accompanied by four pits and an earth mound. Surface conditions were such, that two only of these latter monuments were built throughout the entire line.

The rock post is simply a bronze bolt having a flat head 3 inches in diameter and $\frac{1}{4}$-inch thick with a shank 3 inches long slightly more than $\frac{3}{4}$-inch diameter, in which holes had been drilled so that the cement might grip it. After a point for the post has been located, a hole is drilled in the rock with rock drills and hammer to a suitable depth; this is then filled with cement and the shank of the rock post pressed into the hole so that the head lies flat on the surface. After the cement has set the shank is solidly embedded in the rock. Immediately to the south of each rock post, a pyramidal stone mound 5 feet square at the base and 4 feet high was erected to further reference the position of the post and to aid in its convenient identification. The mound was solidly built from rock and boulders always available in the immediate vicinity, which were roughly hewn and carefully placed in position so that the mound when completed presented as symmetrical and compact an appearance as practicable.

When received by the surveyor the top of the post bore the inscription, "Interprovincial Boundary," "Manitoba," "Ontario," "192–" and the centre point. Before setting the post, the number of the monument, the bench-mark number and the additional figure to complete the year were added by the surveyor by stamping the necessary figures and letters on the soft bronze top with steel dies. After marking, a record of the inscriptions appearing on all posts was made by means of carbon paper rubbings.

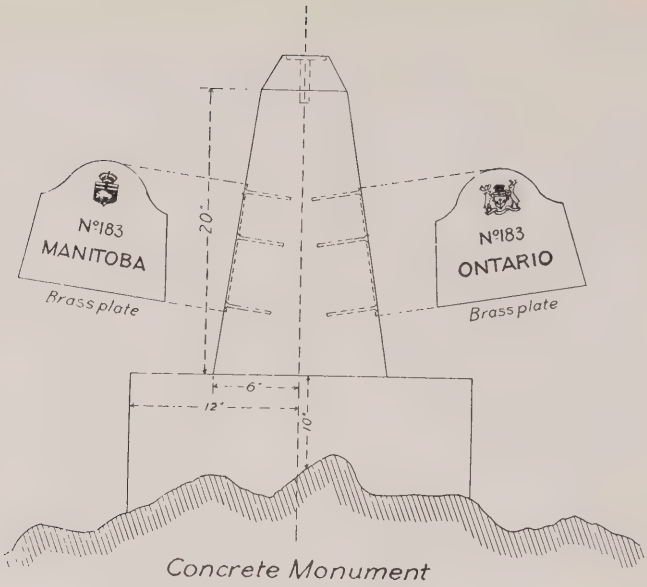
Monuments erected at points where the surface was soil or boulders were similar to those in general use on Dominion lands surveys in wooded country. As previously indicated, there were only two cases requiring this type of construction throughout the entire line. The post used in these cases was a 30-inch x $1\frac{1}{4}$-inch iron tube filled with cement on which, at the top end, was attached a bronze plate similar in every way to the top of the rock posts. The bottom end had an iron plate attached to it, so that when the post was set in the ground and soil tamped around it, the foot plate acted as an anchor and prevented its removal. The post after being marked was placed in a suitable hole prepared for its reception at the point selected, and earth filled in around it, so that the bronze cap was flush with the surface. Four pits, 3 feet square and 18 inches deep, were then dug and the excavated material was used to construct a pyramidal mound 5 feet square at the base and 3 feet high, as on Dominion lands surveys.

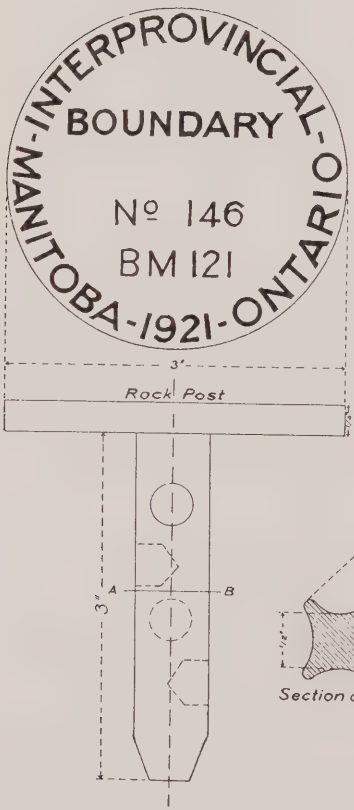
The following is a list of equipment and tools required in the construction of monuments and marking of posts:

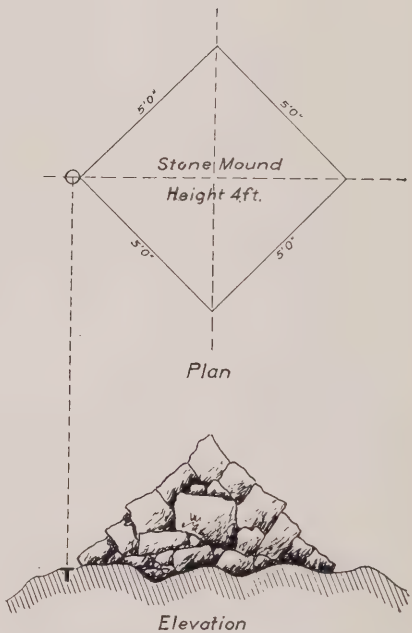
For Marking Posts

1 set dies

Carbon paper pad for recording inscriptions on posts after they are in place







Concrete Monument, Rock Post, and Stone Mound

For Marking Plates

1 set templates, Nos. 0, 1, 2, 3, 4, 5, 6, (9), 7, 8 with blanks for spaces
1 jig to hold templates
½ doz. drills with collars attached
1 hand drill

For Construction of Concrete Monoliths

Set of forms for shaft
Small form for pyramidal top
Rough form for base
3 pack sacks for carrying material
1 water pail
1 pick
1 rock hammer
1 mason's trowel
1 mason's spirit level
1 metallic tape
1 spade
1 axe
1 plumb-bob

Additional Equipment for Building Rock Mounds and Setting Rock Posts

1 mason's rock chisel
Set of rock drills
1 drill hammer

Of the types of monuments erected, viz.: concrete monument, rock post with stone mound, and long post with pits and mound, the first two are without doubt of a much more enduring and permanent character than the long post set in the ground. It is difficult to conceive of anything more lasting or less liable to damage from wilful molestation than a bronze post cemented in solid bed rock. The appearance of the concrete monument, with its brass plates is at once the most distinctive and impressive of the three types, while its permanency is the "permanence of concrete," the durability of which is not yet known.

LEVELS

A source of information important not only on account of its scientific nature but from the data it affords regarding the relief of an area presenting such possibilities for the development of water power or electrical energy, is to be found in the results of the levelling division who operated in conjunction with the survey. Levels along the line were carried on by the usual organization consisting of a leveller and rodman; the leveller, Mr. Palsen, being specially chosen for this duty by the Director of Levelling of the Department of the Interior. Mr. Palsen was able to carry on this work through the entire line, a feature that proved very satisfactory to the remainder of the staff.

The elevation above mean sea level of all monuments erected, summits, depressions, lakes, and rivers intersected by the line and others close to the line in addition to numerous ground elevations along the line, were obtained from a main line of levels carried along as the line was opened out. The accuracy of this line was in all cases checked by the running of an independent second line of levels. Levels were started from bench-marks on Winnipeg river, that had previously been established by surveys made in connection with water power investigation in that district. As the elevation of these bench-marks was in doubt, due to the fact that much of the investigation was of an exploratory nature only, a connection has been made by the Director of Levelling of the Department of the Interior between the bench-mark from which the boundary levels were started and a precise bench-mark at Molson on the Canadian Pacific

TYPICAL VIEW OF STONE MOUND
Monument No. 190 at 202 miles, 57·41 chains, elevation 1116·0 feet

railway. This enabled the levels along the boundary to be reduced to sea level and their inclusion with the vast network of official elevations recorded throughout the Dominion of Canada.

All monuments erected during the survey were used as permanent bench-marks, the centre mark on the post being the point of recorded elevation. In order to prevent any uncertainty regarding the identification of the bench-mark, all bench-marks were marked by dies, with the letters B.M. followed by the distinctive number. Bench-marks were numbered consecutively as they were placed from the commencement of the survey, a complete description of their locations forming part of the level notes. In some cases, conditions governing the position of monuments resulted in their being erected at a considerable distance from where main waterways crossed the line. As any future

investigation of water-power possibilities would naturally follow rivers and lakes an additional bench-mark was placed on the line in convenient proximity to the water, where this occurred. The bench-mark used in these cases was a bronze bolt with a plain head, somewhat smaller than the head of the standard rock post, this being cemented in a hole drilled in bed rock in the same manner that rock posts are placed.

A summary of the levelling results is presented in the form of a profile forming part of the information shown on the final boundary maps in the accompanying atlas. As the course of the line was approximately at right angles to waterways, levels furnish the elevations of a succession of divides and bottom lands extending from Winnipeg river to the twelfth base line along the boundary.

Undeveloped Water Powers in the Vicinity of the Boundary
Falls on Pigeon river

While this information, in conjunction with that obtained by the topographical division, covers relatively a very small area of this vast and comparatively unknown district lying between lake Winnipeg and Hudson bay, it however serves as a base or control from which lateral investigations may be extended as required. Water power is one of the great potential assets of this area that must be developed in the future to meet our increasing requirements. The Dominion Water Power Branch of the Department of the Interior has already extended preliminary investigations for this purpose up the Bloodvein, Pigeon and Berens rivers from lake Winnipeg to within a few miles, in each case, of the boundary. The power already developed on Winnipeg river at Pointe du Bois, the one now being developed further down the river near Lac du Bonnet together

with the active investigation now being made of the possibilities of the headwaters of this river in the province of Ontario all serve to demonstrate the importance of this level information.

TOPOGRAPHY

While the primary object of the survey was the delimitation of the boundary line, the nature of the surveys offered an exceptional opportunity for the collection of a great amount of important topographical information and data through an area that is as yet comparatively unknown and unmapped.

Although the field notes taken while chaining gave accurate data regarding the position, extent, and character of forest cover, surface conditions, and water areas, this is limited to one ordinate only, being that in which the direction of the line was run. The extent of the other ordinate is only very approximately indicated, being confined to what it was possible to observe directly from the line. While levels add to this information by furnishing data regarding relief, the total information is so meagre as to make it impossible to prepare maps that would show other than very general topographical information.

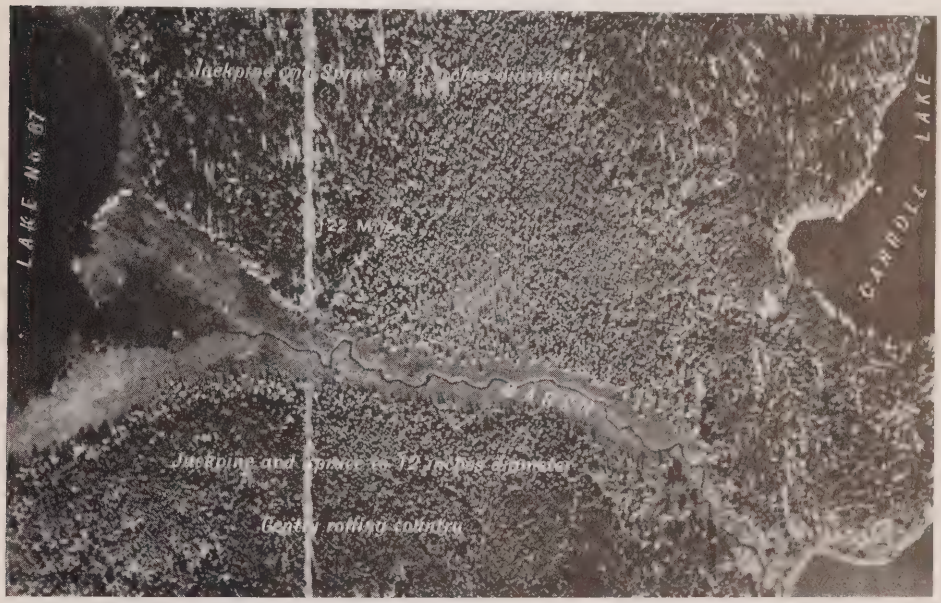
At the initiation of the survey, this was recognized and a special topographical division was organized to map the country for a mile on either side of the line. It was appreciated however that this work, notwithstanding its importance, must necessarily be subordinated to the main object of the survey and that it should not be allowed to impede its general progress. Shortly after survey operations were commenced, it became apparent that a much greater percentage of the country was covered by water than was known or expected. This resulted in topographical features assuming a decidedly complex nature at the same time making the amount of labour necessary for their survey greater than was available. It was therefore decided to limit the work of the division to the survey of water areas only, these being the most important and extensive of the topographic details and to rearrange its personnel so that it consisted of an instrument-man and two rodmen.

The main sources from which the topographical information contained in this report and in the accompanying atlas is obtained are as follows:—

1. Topography contained in the chainage field notes
2. Stadia traverses of water areas
3. Levels showing relief
4. Compass and micrometer surveys of water areas made by the geologists
5. Track surveys and explorations made by various members of the party
6. Aeroplane photographs
7. Information obtained from traders, trappers, and prospectors of the district

As already indicated, the most extensive of these operations was the stadia traverse of water areas. Numerous bodies of water with extremely irregular shores were constantly encountered during the entire survey. All those inter-

sected by the line, and as many more in its vicinity as could be undertaken, were surveyed by the stadia traverse method used on the survey of Dominion lands and so extended did this network of water become that it frequently became a difficulty to know when to stop traversing. It was endeavoured to completely traverse all areas commenced and particularly those along water routes crossing the line, even though this at times prevented the traversing of smaller insignificant areas in the interior. The amount of traversing accomplished is somewhat over 1100 miles, there being over 6 miles of traverse for each mile of line cut. Now that maps are available showing these waters in their relation to the line, the collection of the additional topographical data



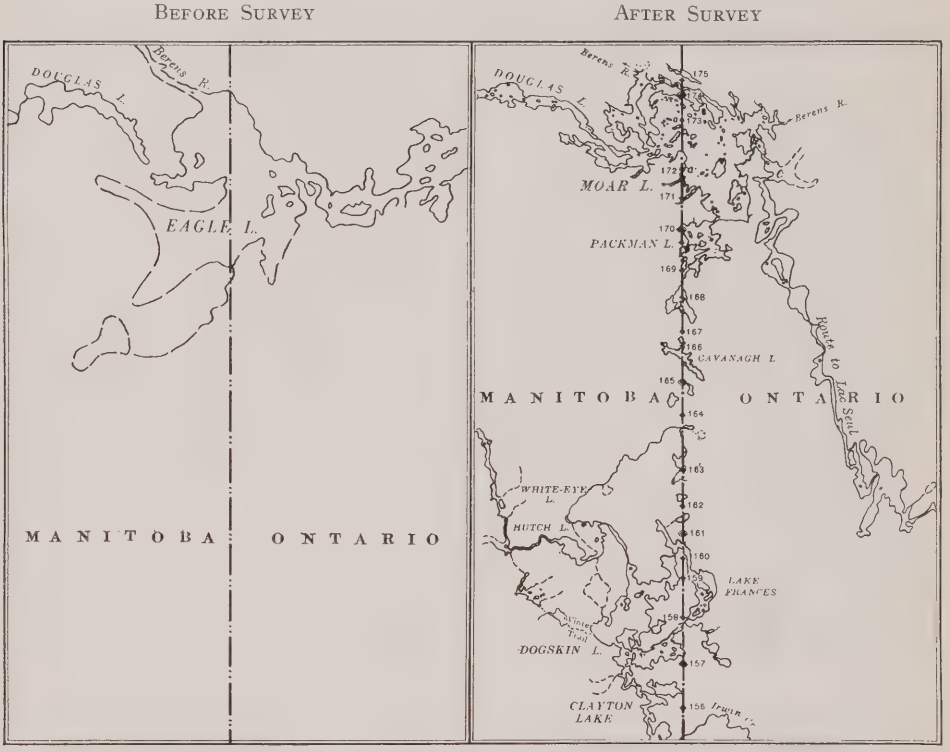
AEROPLANE PHOTOGRAPH OF SECTION OF THE BOUNDARY

Official photograph by the Royal Canadian Air Force of the line through timbered country at Mile 122 near Carroll lake. Scale is approximately 1 inch to 6 chains. The creek crosses the line at 121 miles 70·46 chains and is described in the field notes as 10 feet wide and 16 inches deep. The field notes are the source of the descriptions added to the photograph.

regarding distribution of forest cover may be obtained much more conveniently and accurately than was heretofore possible. The most convenient and satisfactory method of accomplishing this is by means of aerial photography.

The Royal Canadian Air Force of the Department of National Defence has a station at Victoria Beach, near the southern end of lake Winnipeg from which place regular patrols of the timber lands to the north and east of the lake are made in the interests of the Forestry Branch of the Dominion of Canada. In conjunction with this, a series of vertical photographs was taken over the boundary line from Winnipeg river to the twelfth base line.

These photographs when carefully assembled present the topography of the country in plan, on a scale of from six to seven chains to an inch. The minor detail of lakes, islands, and streams, which cannot be obtained by stadia traverse methods except at unwarranted cost, is recorded in the photographs and after being reduced to proper scale can be transferred directly to the map. In so far as these photographs furnish new information it has been added to the boundary maps but on account of the low altitude at which the hydroplanes made their flights the field of the photographs is restricted to a narrow strip



Comparison of available information along a portion of the Ontario-Manitoba Boundary before and after survey.

along the boundary and hence the photographs contain little additional topographical information.

In addition to water areas the photographs constitute a remarkable record of the areas of muskeg and rock outcrop and of the forest cover. With the aid of the field notes of the boundary survey there is no obstacle to an accurate interpretation of the photographs in the above particulars and even the relief of the country can be reliably estimated by comparison with the profile of the boundary line.

A series of aerial photographs not only furnish reliable data concerning water areas more economically than it can be obtained by a ground party, but at the same time furnish material for the study of geological and forestry problems.

GEOLOGY

As stated elsewhere in this report, the geologists added greatly to the mapping of water areas by the traverses they made, these being mainly areas farther from the line than the stadia traverses reached. Outside of that again, in some cases, considerable exploratory and track survey information was collected by such of the members of the party as had occasion to travel there. While little or no pretension is made regarding the accuracy of the information obtained from the track surveys, it however serves to show on maps the approximate position of routes that may be travelled, together with the relative positions and lengths of portages or other obstructions to navigation. This would enable strangers having occasion to use these routes, to find them with much less difficulty than members of the party experienced. Additional information mostly in regard to routes of travel or the positions of outstanding water areas was collected from time to time, from trappers, traders, and prospectors. Subsequently during the course of the survey, a major part of this information was verified and now forms part of the returns. In some of the districts more remote from the line, no verification was possible, but where its source is considered trustworthy and it is of sufficient importance, it is indicated on the general maps. Information of this nature is frequently so misleading, confusing, or vague as to be utterly unreliable and it is only after it has been thoroughly investigated that any of it may be depended upon. From time to time, the line crossed the headwaters of rivers flowing into lake Winnipeg that were unmapped beyond a few miles back from the lake, and over which there was no occasion for any of the members of the survey party to travel. From information such as has been described, it has been possible in some cases to identify the river crossing at the line and to indicate its connection with the part of the river already mapped.

A party of geologists was attached to the survey by the Department of Mines of the province of Ontario for the purpose of investigating as completely as possible the geology of the district along the line. During the first year while the line was passing the Rice Lake Mining district, the geological party consisted of three men with Dr. E. M. Burwash, one of the professors from the University of Manitoba, in charge. The following season Mr. H. C. Rickaby, who had assisted Dr. Burwash the previous season, continued the investigations with the help of one assistant.

As a report of these investigations is available in the official publications of the Ontario Department of Mines,* it is not considered necessary to include more than a reference to this subject here. Apart from geological investiga-

*Volume XXXII, Part 2, 1923.

tions, the geologists and the topographical division of the survey party had the common object of surveying, mapping, and exploring water areas. As a rule all water areas close to the line were surveyed and plotted by the topographical division. These plots furnished the base on which the geologists entered their information. In the more outlying districts, they themselves made surveys, usually by means of the compass and micrometer and these surveys were tied to our work. In addition, numerous water areas were plotted from track surveys or explorations carried on both by the geologists and members of the survey party.

In the carrying on of this work it was found advantageous for both parties to co-operate with each other. Frequently the geologists assisted the topographers on their stadia surveys, carrying on at the same time geological investigation, while members of the survey party, on occasion assisted them. On moving days, when all for the time being assisted in moving and setting up camp the geologists shared in the task and were to all intents, members of the party.

While the boundary survey doubtless afforded an opportunity for a more economical geological investigation on the part of the Department of Mines, than would have been the case had it been necessary to organize a complete separate party for the purpose, the survey itself benefited greatly by the co-operation of the geological party. This has resulted in the topographical maps being much more complete and comprehensive than if they had been prepared solely from our own surveys. As information was collected by both parties it was adjusted, assembled, and plotted on the same sheets and this will result in the same topographical information appearing in many of the final maps both of the boundary itself and of the geological maps of the Department of Mines.

MAGNETIC OBSERVATIONS

As the survey extended through a district in which no information had ever been obtained in regard to the magnetic declination, this was measured at frequent intervals throughout the survey, and the results are shown in the table of appendix.

These observations were made on the line by means of a six-inch telescopic compass with a microscope eye-piece, attached to the standard of the Cooke transit. With this instrument readings could be made to a single minute of arc, and each observation is composed of the mean of five separate readings.

The results show very considerable variation in the value of the declination, as was to be expected, for this territory is of Laurentian formation the rocks of which carry large amounts of magnetite which always deflects the magnetic needle very appreciably.

PHOTOGRAPHS

Aside from the photographs made from the air by the Royal Canadian Air Force, it was necessary for purposes of record to photograph all concrete monuments after they were erected. In addition to this, numerous other photographs

were taken while in the field illustrating various phases of the survey, selections from which are produced herein. Characteristic stands of timber and forest cover, representative views of the boundary line, typical water areas, and views of second-class monuments were all photographed so that the illustrations here shown may depict as accurately and fully as possible all of the various conditions met with. Besides cameras and films, chemicals and developing tanks were taken to the field so that negatives were made shortly after exposure. This enabled the convenient re-photographing of any important view that on development resulted in a faulty negative.

TRANSPORT AND CAMP OUTFIT

The method of transport and the character of equipment both for transport and camp outfit, suitable for the requirements of this work, involved the most serious consideration and at times presented the greatest difficulty that was encountered. On account of the rocky barren nature of the district and the occurrence of the numerous water areas, it was not possible to use pack horses or teams, mainly for the following reasons:

1. The entire absence of horse feed
2. The impossibility of economical location and construction of pack trails or roads

Waterways were accordingly the only means of transportation afforded by the country during the season of navigation and it was necessary that equipage be designed to meet the requirements of transport of this nature. As the prevailing direction of the waterways of this district is towards lake Winnipeg and consequently crossing the line more or less at right angles to the natural direction of transport they did not assist the transport as much as would on first thought be expected. The line after crossing a waterway climbed over the next divide and then across a second waterway and so on continually. The problem of finding a suitable route connecting these waterways was constantly recurring and frequently involved circuitous detours between waterways. On account of the uneven surface of the country, it was seldom possible or economical to attempt the transport of any quantity of camp outfit, provisions, or materials along the line. This therefore had to follow the waterways which had previously to be explored and the necessary portages located and opened out. Travel along even the main waterways was constantly interrupted by falls and rapids necessitating frequent portages. These were however usually short. On the transport routes that were opened during the survey between waterways the portages were usually longer, in some cases being over two miles in length.

It was found that the most satisfactory method of handling supplies was to have the main supplies forwarded to the district during the previous winter and placed in a series of caches along the line and on the most important water routes. These were freighted with horses as far in as they could operate, and

from this point they were forwarded by means of dog train. As the field work progressed the freighters procured the necessary supplies from these caches and brought them to the survey camp as required, thus relieving the summer transport of a vast amount of labour that would be involved were it necessary to forward an entire season's supply. In order to successfully forward supplies and place them in caches in advance of the survey it should not be left until the winter is far advanced on account of the depth of snow that is encountered during February and March. During the latter part of March and in April the break-up takes place, when nothing can be done. Generally the most suitable time for work of this nature is during December and January or as soon as possible after the ice is firm and before the snow becomes too deep.

Dog feed is an all important consideration in this connection, and from experience it is not advisable to count on procuring a sufficient supply in the district without previous arrangement. This is due to the fact that the native dogs are seldom suitable for continuous work such as is required and that suitable dogs must be brought in. The natives usually only put up sufficient dog feed before freeze up to do their own dogs and consequently there is no extra dog feed available in the district. It is necessary that sufficient fish be caught before the lakes freeze and cached at convenient points for the ensuing freighting.

Were it possible to have a rapid exploratory survey of the district through which the line is to be run, made in advance of the survey so that a fairly complete knowledge of the position and course of water routes would be available, it is probable that winter transportation of supplies might in some cases be entirely dispensed with. While this could be done in this district now that the necessary information is available it would not have been safe to have ventured on this course without this knowledge. Further, after an exploratory survey is made there would not then be sufficient time available to procure and forward supplies before the termination of winter, in the event of its being found that there were not satisfactory water routes in the district.

The customary mode of transporting the local supplies and moving camp as the line progressed was to concentrate the outfit in main camps where the line crossed main water routes. When it became necessary to move the camp ahead, it was moved around through the routes that had been located to where the next main route crossed the line. Frequently these detours were 10 and 12 miles away from the line and resulted in the new camp being entirely too far ahead to be of any service for several days. When this occurred, the line party carried a supply of provisions and light camp outfit with them along the line, sufficient to do them for the probable length of time necessary for the line to reach the new camp. This light outfit was portaged ahead usually every second day, the method of camping being usually called, "fly camps." As a great many portages had to be made on the route along which the camp was being moved, the number of men left could be so adjusted that the time required to move camp and set it up in its new position would be the same as the time required for the line to reach this place.

Portaging and canoeing were everywhere in evidence in this work and pack sacks, pack sheets, and tump lines were used extensively. The type of tump line or pack strap used is slightly different to that in ordinary use. Instead of the straps being permanently sewn to the headpiece, it was found advantageous to have buckles attached to each end of the headpiece and the straps simply buckled to it. This allowed of an adjustment in the length of the strap after a pack was made up without undoing the pack. The pack sacks used were similar to the type ordinarily found on the market, except that they were made to order from specially selected stock with a view to greater durability and service. As these were used extensively in carrying cement, sand, and broken stone along the line, it was important that they be strongly made. The pack sheet is simply a sheet of canvas with a sleeve on either side about 6 feet by $2\frac{1}{2}$ feet. The straps of the tump line are passed through these sleeves and the sheet is used as a container in which to pack miscellaneous camp outfit or provisions. As supplies had to be so frequently handled both in canoe and by portaging and in unsuitable weather, canvas waterproof bags were used for the protection of groceries or other articles liable to injury from water.

On account of the numerous obstructions to navigation, necessitating the constant loading and unloading of canoes and the carrying of them across the portages, it was advisable that lightness and capacity be considered in the type of canoes used. Canvas covered canoes 17 feet in length were found to be best suited to the requirements of this district; larger canoes, besides being more awkward to carry, are on account of the increase in draught, not readily navigated in shallow water. The normal load for a 17-foot canoe with two boatmen in this district is 1000 pounds. For traversing and exploring much smaller canoes of the same type of construction were used. This work, especially the traversing, is very hard on canoes, since it is necessary that they follow the shore of water areas where sharp rocks and reefs are continually encountered. It is not often possible for those engaged in traversing to take advantage of the lee shore, hence at times they have to follow rocky shores through shallow water with a wind blowing full on shore. Even when carefully handled by expert canoemen the life of a canoe is very short.

Another constant need for canoes, though calling for a radical difference in type, is for purposes of crossing and recrossing water during the survey of the line itself. Water areas are so irregular and so constantly encountered along the line, that it is out of the question to attempt to walk around them and canoes must always be kept within convenient reach of the party engaged on the line. The axemen, transitman, chainmen, levellers, and mounder all had to cross and frequently recross waters at different times. The desirable characteristic of canoes for this purpose is that they be of as great carrying capacity and minimum weight as it is possible to procure. To a great degree strength and durability may be sacrificed in order to obtain these features. These canoes have to be carried often for considerable distances along the line or through the bush, up and down precipitous cliffs or across marshes, where it would be extremely

difficult to carry strongly built and consequently heavy canoes. The 50-pound special chesnut canvas covered canoes were used for this purpose and proved as satisfactory as any type of canoe on the market. These readily carried four men and would on occasion accommodate five. If they were used exclusively for this purpose they would undoubtedly give several seasons' service, but they were frequently appropriated by the traverse party or used for freighting purposes, with the result that two seasons' service only was secured from them.

In certain areas comparatively large bodies of water were free from obstruction, over which there was considerable freighting. In these places an Evinrude outboard motor was efficiently used to tow canoes and reduce labour.

A Frequent Type of Portage in the District
Portage on chain of lakes east of Davidson lake

Camp outfit was reduced to the least minimum consistent with the requirements and it was necessary on occasion to exercise some supervision of personal outfits brought in by members of the party. Silk tents and flies, where they could be used instead of tents, reflectors instead of stoves, and eiderdown sleeping robes instead of blankets were used to advantage.

Modern science has not yet succeeded in devising a method of cooking for a large party of men in the bush, where the men themselves have to furnish the necessary transportation of cooking utensils, that is superior to that of the reflector. This is yet in common use through the outlying parts of Northern Ontario and Quebec but it is seldom seen west of there. Requirements were amply met by four folding reflectors in the hands of a cook who fortunately had had previous experience in their use. These are suitable however only for summer use in districts where fuel is plentiful.

The transport equipment consisted of the following:—

4 seventeen-foot freight canoes
2 fifteen-foot fifty-pound special canoes
1 sixteen-foot guide special canoe
30 tump lines
1 Evinrude outboard motor
12 pack sheets
12 pack sacks
6 canvas canoe covers
6 canvas cache covers

PART OF THE CANOE TRANSPORT

Members of the survey party entering Sasaginnigak lake en route to the commencement of the survey

The selection of the season of the year that was best suited to the requirements of the survey was for a time the occasion of some doubt. Base lines had been run to advantage in the winter through districts similar to this, and there at first appeared to be many advantages in the operation of the boundary survey through the winter months. These consisted mainly in the comparative ease with which transportation may be accomplished by means of dogs through country where no trails exist while the snow is on the ground. Then too, in regard to the opening of the line, when the ice is formed, triangulations with all the incident labour regarding the clearing out of the bases, the reading of the angles, and the solution of the triangles would be entirely eliminated. While there are factors, and very important factors too, that have proven their value in the successful operations of winter surveys, it was apparent that although

these to a great extent obtained on the boundary they were more than counterbalanced by other conditions peculiar to this survey of which the following may be mentioned.

1. The length of winter season in the district is 4 months while the summer season is 5, thus allowing an additional month to the summer operations with the same time of assembling and disbanding the organization.

2. While it is possible to so protect concrete that it will set in cold weather considerable trouble is entailed. The locating of sand and gravel for the construction of monuments would be extremely difficult when the snow is on the ground. The location of stone suitable for building stone mounds would present even greater difficulty.

3. The presence of snow on the ice would prove a serious handicap to traversing water areas.

4. The amount of camp outfit, tent accommodation, and stoves is much less than that required for winter operations thereby materially decreasing the demands on transport.

5. While the co-operation with the geological division attached to the party by the Department of Mines of the province of Ontario is an issue apart from the main object of the survey, it would not have been possible had operations been carried on in the winter.

6. It is doubtful whether the temperature of the chain can be determined by field methods as accurately in winter weather as it can during the summer when its temperature is comparatively near to the standard temperature of the chain.

Without regarding the usual hardships and exposure to which the party would be subjected, it was considered that the foregoing reasons were sufficient to make it advisable that the work of the meridian section of the boundary be carried out during the summer season. Accordingly, the general plan of organization was arranged with this in view.

CHAPTER IV

SURVEYS

Transportation of Supplies, 1921

Instructions authorizing the survey of the meridian section of the Ontario-Manitoba boundary were issued on March 7, 1921. Although it was then late in the winter, the importance of forwarding as many of the supplies and articles of outfit to the field as possible for the ensuing season was realized and preparations for this work were at once commenced.

While it was most desirable to make an exploration of the district through which the operations of the following season were to extend in order to determine the position and possible value of what transport routes there were and to forward and cache supplies at convenient points for use during the entire season, there was not time to undertake all this. In order to use what remaining time there was available for winter freighting to the best advantage, it was decided to procure the estimated quantity of supplies with which to carry on operations after the line had reached the region of Snowshoe lake and to forward these over a winter road that was then in operation to the Rice Lake mining district, this being known to be close to the boundary. The part of the line south of Snowshoe lake was therefore left to be accommodated by summer transport.

Between nine and ten tons of supplies were purchased in Winnipeg on the 14th of March and after being suitably packed they were shipped to Lester reaching there on March 17th. From that point they were taken by freight teams to the terminal of the sleigh road at Gold lake where several mining companies were in operation. This route passed by Fort Alexander and here native drivers and dog trains were engaged to forward the supplies on from Gold lake. The first of the freight reached the end of the sleigh road on March 23, and a few days later it was all delivered there. This was then divided and about one-third was forwarded to the southeast to Long lake over a road that had previously been opened out, but had not been used this winter. This was finally cached at the east end of the lake about 10 miles from the line in a building owned by Mr. Edmonds who has mining claims here and who undertook to protect the cache. The balance of the freight was forwarded northeast from Gold lake by dog trail to Wallace lake. As the snow was then starting to thaw and a possible breakup was imminent, every effort was directed towards forwarding the freight from Gold lake, from which there is no direct summer route either to Long lake, or Wallace lake. During the afternoons the snow became so soft that the dogs could not freight and advantage had to be taken of the frost of early forenoon and late evening. It was with a feeling of relief that the

last of the freight was finally delivered at Wallace lake and that somewhat cooler weather set in.

While this freighting was progressing an exploration of the district to the east and north of Wallace lake had been made, which disclosed the presence of Siderock lake and of Wanipigow river leading into its east end from across the line. To the north of Siderock lake a dog trail was opened for about three miles to a large lake called Obukowin which in turn was found to be connected to the east with another large body of water subsequently named Carroll lake that was evidently in the vicinity of the boundary. The positions of these lakes relative to the boundary were determined by means of rough traverses made with the chain and surveyor's compass assisted by pocket compass and pacing. The supplies were again divided, part being cached on Wanipigow river, near the line to the east of Wallace lake, while the greater part were taken through to Obukowin lake and finally cached on an island in that lake. Freighting during the day time, except for a brief interval in the morning was now not possible and operations were to a great degree carried on at night. Toward the end, water on the ice began to be troublesome and sleighs with runners had to be improvised to replace the toboggans, which could not be allowed to drag through the water loaded. As a result of the efforts of these Fort Alexander natives who loyally supported to the utmost the endeavours to forward the freight as far as possible, the final loads reached the cache on the second morning of April and a return to Wallace lake was made that day. Rain had been falling lightly during the past two days and water now covered the ice in places a foot deep so that frequently there was apparently aimless meandering in the courses followed by the freighters in order to escape the deeper water.

This completed the freighting operations for the spring. The snow was then disappearing rapidly and bare ground was in evidence, while on the second day during the return to Fort Alexander a heavy rain started at noon and lasted through the following night. Frost, however, again set in and the party reached Fort Alexander without mishap where they were discharged. On account of the brief time that was at the disposal of freighters, their efforts were remarkably successful although a great part of the freighting was necessarily left to the summer transport.

Organization

During the interval between the termination of freighting and the commencement of the survey, chainage apparatus, the necessary distinctively marked posts of various types, monument plates, forms, and numerous other articles of equipment were prepared and assembled in Ottawa.

A party of 24 was engaged in Winnipeg on June 2 and was taken by train to Pointe du Bois on Winnipeg river to which there is a bi-weekly train service from Lac du Bonnet. Supplies with which to start operations had also been procured in Winnipeg and were shipped on the same train to that point. Here canoes were put into commission and were used in transporting the party and

outfit up the river to the boundary, a distance of about 25 miles. This trip was made in one day, there being only one obstruction known as Lamprey falls, about 8 miles up from Pointe du Bois, where there is a lift over of only a few feet in distance. The name Lamprey falls is now a misnomer as it has been almost completely flooded out by the raising of the water below here in connection with the power development at Pointe du Bois. It is now only a rapid and is usually run by other than heavily loaded canoes coming down the river. As would be expected the raising of the level of the river below this falls

Spring Flood in Winnipeg District
About one mile of the railway to Pointe du Bois was under water at the time members of the survey party passed through

has flooded out much of the adjoining bush land. While there were several places with swift current above here, no portages were necessary and the first camp was set up on the bank of the river close to the line that same day.

Commencement at Winnipeg River

Actual survey operations were commenced the following Monday morning, June 6, from the monument on the south side of Winnipeg river marking the termination of the boundary surveyed in 1897. This point was on bare rock at the bank of the river about 30 feet above the water, and the monument as originally built consisted of an iron and a wooden post standing in a pile of stones.

When found, the wooden post had disappeared while the iron post had fallen over and was lying beside the pile of stones. The bearing trees that had been marked at the time of this survey were still standing and permitted of no uncertainty regarding the exact location of this point. Before the party left the district, this monument which was in poor condition was completely destroyed and replaced by one of the standard concrete monuments used thereafter. The original boundary line, though visible, was so grown up and filled in that it was necessary to clear it out for some distance back in order to get a direction with which to continue the production. It might be mentioned also that the wooden post marking 58 miles was found badly decayed and in a fallen condition. Township subdivision of the Dominion Lands system of survey had been extended

THE STARTING POINT OF THE SURVEY

Concrete Monument No. 82 at 58 miles 27·20 chains, erected on the south bank of Winnipeg river, replacing iron post in cairn of stones built in 1897 to mark the end of the boundary then surveyed

along Winnipeg river to this boundary and a connection was made between the boundary and monuments of this subdivision as the section lines were crossed. Slightly past mile 69 the fifth base line of this system was intersected and the nearest monument was connected to the boundary.

From the outset the opening of the line and all the various operations in connection with the survey were carried through as have been described in the previous chapter under Methods of Survey and it was not found necessary at any time to depart from these methods. Line clearing, though at all times vigorously pushed ahead, was occasionally materially interfered with by the excessive amount of labour involved in the transportation necessary throughout

the season and particularly until the line had reached the vicinity of the first cache on Long lake. The packers immediately started freighting goods in from Pointe du Bois to the line and forwarding them ahead through Ryerson, Shinewater, and Davidson lakes. The Evinrude motor proved of great value particularly on Winnipeg river. Portages of a mile and even greater were quite frequently crossed in the transport route that was opened out and used along the line and this necessitated at times the entire party being engaged on transport duty at the expense of line opening.

Only sufficient supplies were brought in to Pointe du Bois and up Winnipeg river to enable the survey to reach Snowshoe lake on the Oiseau river system. From here, supplies were brought in directly from Lac du Bonnet up Oiseau river along which there are 14 portages to Snowshoe lake. On the line passing Snowshoe lake, the packers connected with the cache at Long lake and were thenceforth able to handle the transport themselves with only occasional assistance from the other members of the party on moving days.

Transport Route, 1921

The route followed by the transport from Winnipeg river northerly during the season of 1921 may be summarized as follows:

From Winnipeg river at a point a short distance west of the boundary line, a small creek was followed for about one and a half miles, and an 85-chain portage was made to Ryerson lake. From Ryerson lake the best route found was up a creek at the east end of the lake for a quarter of a mile where a 20-chain portage was cleared out to a small lake from which a 25-chain portage led to Shinewater lake, this lake being on the line at mile 70. Two portages, the first of 25 chains and the second of 40 chains, with two small ponds between, were cleared out from Shinewater lake to Marijane lake across the bare rocks and through the burnt timber characteristic of this portion of the country. From Marijane lake a 24-chain portage was opened to Davidson lake. The line crosses near the middle of this lake at mile 73. From the outlet of Davidson lake a circuitous route westerly was opened out to Snowshoe lake by way of lakes 12, 13, Star, and Tulabi to Oiseau river and thence to Snowshoe lake. The boundary line instead of passing near the eastern end of Snowshoe lake was found to pass about three miles farther west.

From Snowshoe lake the route followed up a creek that enters Snowshoe lake just east of the line, and after crossing lake No. 25 a portage over a mile long was made from its north end to the southern end of lake No. 27. This lake drains through a creek into Octopus lake and an 18-chain portage connecting these two lakes was made. A 24-chain portage was made across the height of land between Octopus lake and lake No. 30, from which a second portage 18 chains long was made along the small creek flowing into Johnston lake, and from the western arm of this lake a portage of one and one-half miles was made to the south end of Wingiskus lake. From Wingiskus lake an 8-chain portage

was made over the height of land to Bee lake, thence to the south branch of Manigotagan river, through Gem and Garner lakes, and by the north branch of Manigotagan river through Beresford, Moore, and Wallace lakes up Wanipigow river, and by way of Siderock and Obukowin lakes to Carroll lake.

The last day's work in the field was on October 14, after which the party returned to Winnipeg.

During the season a stadia tie line connection was made between the line where it crossed Garner lake and a wooden post marked XV in a stone mound on an islet near the south end of Beresford lake. This monument was erected in 1919 by B. W. Waugh, D.L.S., while making an extensive traverse of lakes in the Rice Lake mining district.

A serious accident was narrowly averted as the line was crossing Bloodvein river between Carroll and Obukowin lakes. A hanging tree along the line was

Poplar Timber on the Shore of Carroll Lake
This timber often reached 20 inches in diameter. The tents of the survey party may be seen along the bank of the lake

dislodged by the wind and fell without warning on the surveyor in charge of the party and he was taken unconscious to camp where he did not recover consciousness for 20 hours. He was attended to in camp and on the party leaving the field two weeks later, he had recovered so that with the assistance of the men, he was able to reach town. Three weeks after the accident, on examination, the X-rays showed that the collar bone had been broken and two ribs were splintered but so effective had been the rude attention available in the field that no further medical attention was necessary.

Conclusion of 1921 Operations

For some time, the question of the most suitable route for the return of the party had been the source of some consideration and not a little speculation. Of several routes possible, only two were suitable. These were, to descend

Bloodvein river, the headwaters of which the party were now on, to lake Winnipeg and to go by boat up that lake to Selkirk, or to return by the transport route that had been opened during the season along the line to Oiseau river and down that river to the railway station at Lac du Bonnet. Every part of this latter route had been travelled over, during the season, by one or other of the members of the party and the length and condition of the 33 portages, many being over a mile in length, that must be negotiated, could be vividly recalled. This route was however a known quantity to the party and at Lac du Bonnet there was the certainty of train connection, there being a daily train service with Winnipeg. During the season it had been generally assumed that the return would be by way of one of the rivers to lake Winnipeg, but as the headwaters of Bloodvein river were reached and the difficulty of finding the route where the river passed through such lakes as Carroll and Obukowin, became apparent, coupled with the fact that it was known that there were more lakes below these, that would have to be passed through, it was finally decided not to attempt this route. Further points that were considered in connection with this river were (a) Over half of it was entirely unmapped and the portages particularly at the upper end were known to be unused. (b) The probable length of the river to lake Winnipeg about equalled the distance along the line to Lac du Bonnet. (c) It had not been possible to arrange that a boat meet the party at the mouth of the river and it was considered probable that there might be a delay here. It was even possible that navigation would be closed, in which event, the situation would become calamitous.

During the week prior to the return of the party, cold weather set in and ice commenced to form on some of the smaller lakes and on the marshes. This, coupled with the fact that snow had already fallen and was remaining on the ground, caused considerable anxiety through the party so that on the 15th of October the date on which it had been decided to commence the return, all was in readiness and an early morning start was made. The weather proved particularly suitable for travelling, until Snowshoe lake was reached. The sun came out bright and clear and the days warmed up, in contrast with the cold, cloudy, murky weather that had been experienced for weeks past. While crossing Snowshoe lake, a change of weather became noticeable and before night, a downpour of rain set in. Although this made the latter part of the day's trip and the camp that evening disagreeable, the end of the trip was so near at hand that these discomforts were unnoticed. Lac du Bonnet was reached at noon the second day following and the party arrived in Winnipeg by the morning train on October 22 where they were paid off and discharged.

Before leaving the field, the question of the disposal of unused provisions and camp outfit on hand to the amount of somewhat over two tons in weight, was decided by two of the party agreeing to stay on the ground to guard this outfit until the commencement of the following year's operations. Freighting alone of these goods had now cost upwards of $1000; their purchase price was even a greater amount and they were now situated in the most convenient

position for the requirements of the survey. The goods consisted of flour, meat, sugar, and a full line of groceries, in addition to tobacco, clothing, stores, and camp outfit, and it would not have been wise to have left them unprotected where they were, chiefly for the two following reasons:

1. Theft and depredation to which they would be subjected at the hands of the native hunters and their families who were then approaching the district for their winter hunting and trapping.
2. Marauding animals and effects of the weather.

Had these cache keepers not been available it would have been necessary, either to have risked leaving them where they lay or to have brought them out to civilization at an enormous cost and at a vastly depreciated realizable price. A cabin was built at the last main camp on the north end of Carroll lake in which the goods were stored and as there was little to be done in connection with the protection necessary, the cache keepers were employed part of the time in procuring an adequate supply of fish for dog feed, for use of the freighters while operating in the vicinity later in the winter in connection with the forwarding of supplies for the coming year's operations. On the commencement of this work in January following, the fact that men associated with the survey were again in the district, was sufficient protection for the cache and both of the cache keepers were employed thenceforth in freighting.

Summary of 1921 Operations

A summary of the tangible results of the season's operations includes the following:—

1. The surveying of 69 miles of boundary line north from Winnipeg river to the headwaters of Bloodvein river.
2. Erection of 52 permanent monuments of which 17 were concrete monoliths.
3. Traverse of 385 miles of shore line of water areas.

Preparations for 1922 Surveys

At the close of the 1921 survey operations, the attention of the Commissioners was drawn to the importance of a certain amount of exploratory work being done through the winter in advance of the coming summer operations, and to the necessity of having the necessary supplies for these operations freighted to the field and distributed in caches at suitable intervals throughout the district in order to relieve the summer transport as far as possible. This would permit of more continuous effective energy being directed to the actual survey work during the summer, a condition vital to a satisfactory season's work in this country of extremely short summer survey periods.

A conference of the Commissioners was held in Ottawa on January 21, 1922, at which this and other details of the future operations were considered

and decided on. The surveyor in charge of the field work left Ottawa on their instructions immediately for Winnipeg with Mr. Davidson, the senior assistant, where about ten tons of provisions and outfit were purchased. These on being properly packed, were shipped by rail to Riverton, Manitoba, from which point they were forwarded on the ice down lake Winnipeg to the Hudson's Bay Company's warehouse at the mouth of Berens river. The method used in hauling this freight on the ice may be interesting as it has been only recently developed and is confined to use on the larger of the northern waters. The hauling of fish from the various fishing stations all over lake Winnipeg to the railroad is a source of employment during the winter to a considerable number of men who are ordinarily known as freighters. The ice is snow covered and the continual wind results in this snow being packed so densely that it is usually impassable to freight teams. This, in addition to the fact that the extent of the lake often necessitates the freighters being away from the protection of the shore for several days at a time, has resulted in their organizing what is called a "freight outfit" for this purpose. This consists of a snow plough that is propelled over the route to be used, by about 6 teams of horses who operate behind the plough. The ice is completely cleared of all snow and the plough is followed immediately by teams drawing the caboose, horse feed, and loads of freight. Enormous loads of freight are handled in this way by a single team of horses who are drawing on glare smooth ice. The entire 10 tons of the survey outfit were drawn by a single team to the mouth of Berens river once the load was started in the morning. From 20 to 25 miles is the usual day's progress, although within half an hour after the passing of the outfit the road is again usually completely filled in and obliterated. The outfit camps at any point on the ice where night may overtake them, the men sleeping in the caboose which is fitted up as a dining room, cookery, and bunk house to accommodate the party of 10 or 12 men. The horses are protected from the weather by being tied up, facing both sides of the caboose where canvas is unrolled from its sides and extended enough to cover the horses and reach to the surface behind them. The horses thus stand around the caboose all night and as they are sheltered the interior is particularly warm. In the morning this canvas is rolled and tied up to the sides of the caboose. While the overhead cost of the outfit, consisting of snow plough, horses, horse feed, men and cook is high this may be distributed among as many loads of freight as can be assembled which follow immediately behind. At the time the survey freight was being forwarded, a freight outfit was fortunately preparing to leave Riverton for Norway House with about 30 tons of freight and arrangements were readily made with them by which the freight was landed, without delay and in good condition at the mouth of Berens river.

Mr. Davidson left on January 31, proceeded from Riverton across lake Winnipeg to Manigotagan River settlement, where he procured a dog team, sleigh, and driver and went across country to the cache at the end of the line. Here he found that the cache keepers had been daily expecting his arrival and that they had an ample supply of feed and provisions in readiness for an immedi-

ate start of the exploratory investigation north. The contents of the cache were in good condition and had been carefully looked after. A three days' continuous snowfall, the heaviest of the season, had now taken place and this with the fact that snow was thereafter continually falling, somewhat impeded the progress of this investigation as well as of the freighting that was now being carried on up Berens river.

In the course of this investigation, Mr. Davidson with the three men now at his disposal, carried a chain and compass traverse through to the end of his operations which extended to within 40 miles of the end of the boundary. As far as possible, lakes and rivers were used, though it was frequently necessary to open out trails through the bush between these watercourses. Towards the end of February he reached Little Grand Rapids where the dogs were rested a couple of days and the route so far investigated was plotted up. Supplies for the continuation of the investigation had been forwarded to this point from lake Winnipeg by dog team and were there on Mr. Davidson's arrival.

The Hudson's Bay Company Trading Post, Little Grand Rapids, Manitoba
This post is situated about 14 miles west of the Boundary and it was used as a supply depot during the operations of 1922

The weather had moderated appreciably and during the middle of the day the snow became soft and was interfering appreciably with the forwarding of the main freight up Berens river. A few days after Mr. Davidson's departure from Little Grand Rapids, it became evident that the breakup was liable to take place this season much earlier than usual and that additional assistance must be rendered to the freighters now engaged on Berens river, so as to insure the freight being forwarded in as far as was desirable. The exploring party accordingly discontinued their work, which had now reached approximately mile 200 and co-operated with the freighters, until the breakup put an end to freighting on March 23, three weeks later. Although the forwarding of the freight was not now as far advanced as it was intended to be before the breakup, the investigation that had just been made revealed the presence and the position

of some particularly suitable water-routes, hitherto unmapped, by which, once the supplies reached them, these routes could be used during the summer, and the balance of the freighting could be completed by water more cheaply than it could be done in the winter. There was now no necessity to distribute an appreciable part of the supplies as completely as had been proposed; a circumstance that was fortunate, as it could not now have been done in any case.

It was necessary now to leave one of the cache keepers in charge of a large cache to guard it until the opening of navigation. He then engaged canoemen and obtained canoes from the Hudson's Bay Company as had previously been arranged, and forwarded these goods to their destinations after which he joined the survey party a few days after the coming season's operations were commenced. It was important also that the cache at the end of the line be cared for during the breakup, as there was danger of melting snow penetrating the roof and damage might result. As several days had now elapsed since the termination of the freighting, during which caches had been constructed and goods checked and listed, there remained an interval of only about 8 weeks before the time, it was expected, the summer survey party would reach the ground and actually commence operations. While only one cache keeper was necessary for the protection of the cache at the end of the line, Mr. Davidson, if he returned to Ottawa and then came back to the field, would spend considerably over 4 weeks in travelling to and from Ottawa and have only between 3 and 4 weeks at Ottawa in the meantime. The cost of his wages for these intervals of waste time, together with the cost of his transportation would tend to make the short period that he could spend at work, very expensive. By staying in the field with the cache keeper, while there would undoubtedly be some waste time, it was probable that opportunities would be available that would permit of the contents of the cache itself being forwarded ahead of the line, and that a considerable amount of traversing could be carried on by him and the cache keeper, with the result that the summer's operations would be relieved to that extent. From the standpoint both of economy and efficiency, it was advisable that Mr. Davidson remain with the cache keeper and they accordingly left Little Grand Rapids with one dog train on March 27 for the cache about 60 miles south, which they reached seven days later after an arduous trip through slush, melting snow, and flooded ice.

During the interval between the return of Mr. Davidson and the cache keeper to the cache and the arrival of the main party on May 27, Craven and Ford lakes, a part of Artery lake, and some smaller lakes were traversed. Additional exploration by track survey methods was carried through the eastern part of Artery lake and also more was done to Carroll lake, though the end of that lake was not found. By working the dogs at night during the very few frosty nights that occurred that spring, and later by canoe, after the disappearance of the ice and snow, they succeeded in forwarding the entire contents of the cache to lake No. 1 on the headwaters of Bloodvein river, about seven miles north of its former position. It was now situated on the south end of a water-

way that was known, as a result of the winter investigation, to extend within convenient reach of the line for a distance of nine miles north.

Mr. Pierce reached the mouth of Berens river on his return trip to Ottawa on April 2, after a dog trip full of delays due to the breakup along Berens river, which was then in places opening out. The following morning before daybreak he with a dog train and driver started up lake Winnipeg to Fisher River Indian reserve where he could get the train from Hodgson to Winnipeg. On the way, the settlement at the mouth of Bloodvein river was visited and arrangements were made there for a guide to be on hand on the arrival of the survey party, to guide them up Bloodvein river to Artery lake. At Fisher River Indian reserve tentative arrangements were made for the employment of some of the labourers required for the coming season. While the dog trip down Berens river had been somewhat vexatious due to the delays resulting from the breakup, the journey on lake Winnipeg was even more so. Shortly after leaving Berens river on the appearance of daylight, rain set in and continued through the greater part of the following night. While good progress was made at the start of the trip, the water and slush rapidly rose on the ice until shortly after noon, when further progress was impossible. Camp was made and the following morning an attempt at further progress was made. This resulted in only about four miles being covered, when the trip had to be given up on account of the depth of the water on the ice, which was up to the dogs' bellies. The only course now was to wait until the slush was either frozen over sufficiently to carry the dogs, or drained through the fissures of the ice, a period of most uncertain duration, and in this case the source of some anxiety, as dog feed and provisions were limited. Although the sky was anxiously watched, there was no indication of the much desired frost, though before morning, the slush had perceptibly abated and progress was resumed before 5 o'clock. By closely following the edge of the ice along the tortuous winding shore and repeatedly assisting the dogs in places where they could not draw the now practically empty sleigh, a steady continuous advance was made, until Rabbit point was reached near noon. Here, the mailmen, with two loads of mail, en route from Riverton to Norway House and two other dog trains were encountered. This was now the third day of their enforced delay at this place and their supply both of dog feed and provisions was at an end. These teams were well loaded with mail and they had practically decided to abandon their loads here and go across country to the nearest habitation for provisions. They however decided to go ahead, while the trip to the mouth of Bloodvein river was resumed and was reached that evening without further trouble. The next morning at 5.30 Bloodvein river was left and after crossing lake Winnipeg and going to the head of Fisher bay, the Fisher River Indian reserve was reached about 7 p.m. The ice was now practically free of water, except for a few miles when crossing the Narrows and the distance of slightly over 50 miles was made with very little effort.

It was now the 7th of April and snow had pretty well disappeared in this district. In fact, after leaving the ice, the dogs had drawn the sleigh over

almost bare ground for 6 miles from the lake to the stopping place. Early the next morning, the driver with his dogs started back for Berens River so as to utilize to the utmost the very favourable travelling conditions while Mr. Pierce after completing the desired business here, drove to Hodgson and took train for Winnipeg. Both here and in Selkirk further details incident to the approaching organization of the party were attended to, including the overhauling of canoes, arrangement for the earliest possible transportation of the party down the lake to Bloodvein river and a search for desirable labourers for the party.

As it was proposed to complete the boundary as far as the twelfth base line during the coming season, it was appreciated that this could only be accomplished economically by making such arrangements as would enable that point being reached and permit of the return of the party by canoe before the freezeup. While it would have been possible to have continued operations after that date if it had been necessary to do so in order to complete the work, this would have required the bringing to the field of a winter transport outfit of dogs, sleighs, etc., in addition to winter clothing and camp outfit and the taking out from the field, or else the abandonment, of much of the corresponding summer transport and outfit. This replacement of outfit could not be readily or economically accomplished and it would have rendered the cost of the small amount of work remaining to be done at that time, excessive. The end in view throughout all the organization, winter exploration, and forwarding of supplies was that of commencing operations at the very earliest date the party could get on the ground and of so freeing the line party from interruption due to transportation of supplies or moving camps, that it would be enabled to devote every hour of working time throughout the season to effective survey. It was appreciated that the amount of work to be done and the shortness of the season made this condition a necessity, if the economy resulting from the limiting of operations to the summer season was to be attained.

As this was the second season of the survey, it was possible not only to again make use of the services of all of the members of the staff of the former season, which on account of their experience was doubly desirable, but to select from the labourers employed during the former season, those who were known to be the most competent and efficient. The result was, that on the assembly of the party, somewhat over half of the number, including those filling the more important positions as members of the staff, first and second cooks, first and second packers, front chainman, and an appreciable number of the labourers were men of previous experience. As there had been an opportunity sometime prior to the actual organization to carefully select men and to permit those former employees who were to return, to suggest and bring men whom they knew to be desirable, a particularly efficient and competent class of labourers was engaged. Before engagement, all the members of the party were carefully informed of the nature of the work they were undertaking and of its two most important features. These were, in order of merit:—

The necessity of the survey being faithfully carried on at all times and through to its last detail, up to the standard of accuracy required.

The fact that they were being engaged to complete the boundary through to the twelfth base line, regardless of what season of the year it might then be, although it was hoped that this would be before the freezeup.

From the outset, the party operated with this dual aim before them and it was not long before the most ordinary of the labourers had calculated the number of miles to be run and knew to a fraction of a mile just what progress had been made. It soon became apparent that although everything that could be done in the way of advance preparation and an organization of a field party decidedly above the average in point of efficiency, had been accomplished, the progress being made was such as would barely allow of its completion in time to return by water. It was necessary that an average of a mile per day be continued through every working day of the season regardless of weather, in order to reach the twelfth base line, by the very latest date in October that would permit of the return of the party by water. For a while after the commencement of operations this progress was kept up, but during the latter part of June intensely hot weather, broken by considerable rain, set in just as the line entered a district several miles in extent that had once been well timbered. This had been burned over and the surface was now piled high with windfall and burnt timber, the whole filled with an almost impenetrable mass of second growth scrub. The combination of adverse weather and extremely difficult line clearing resulted, despite the utmost efforts of the party, in the progress dropping on some days, to as low as one-half a mile. The surplus mileage that was to their credit before entering this district was soon lost and was replaced by a debit mileage that rapidly became alarming in proportion, and concern was everywhere evident as to the prospect of the goal being reached. The exploration of the previous winter had indicated both this district and a better country beyond. When this was reached in the vicinity of Dogskin lake, there was then the necessity of progressing at a rate of over one mile per day. It was to a very great degree due to the energy and application with which the axemen from day to day carried on their part of the survey that the objective was reached on October 6 and that the party was enabled to come out on the last boat of the season. As an indication of the attitude of the men in this connection, it might be noted that at one time during the season when reaching the objective was being despaired of, the men themselves informed the staff of their willingness to work on Sundays in addition to the regular working days, although they were then working considerably longer hours per day than was usual. Fortunately, it did not become necessary to make use of this very questionable economy.

Mr. Pierce reached Ottawa on April 15 and from that date to the date of his departure for the summer season on May 9, in addition to furthering the completion of the returns of the 1921 surveys, considerable attention was given to the designing and preparation of some special chainage apparatus that would more adequately answer the requirements of work of this nature. Arrangements were also made with the Royal Canadian Air Force for their co-operation with the survey party during the coming season so that the line and the district

immediately adjoining would be photographed from the air and also that mail might occasionally be delivered at camp by aeroplane.

Survey Party of 1922 Leaves Winnipeg

On returning to Winnipeg, it was necessary only to purchase sufficient supplies to take the party into camp and accordingly on May 19 the party and outfit left Selkirk on a tug bound down the lake. This was the first trip of the season and the tug was so loaded down with freight that the captain deemed it unsafe to venture into the mouth of Bloodvein river, which is very shallow. He accordingly left the party at Matheson island, about 12 miles out in the lake on Saturday at 7 p.m. Here the men that were engaged at Fisher River Indian reserve were on hand, and as the lake was perfectly calm, it was decided that although it was late in the day it was advisable to take

The Bloodvein River near Minago Creek With Rapids in the Distance

advantage of the favourable conditions of the weather and to immediately embark in the canoes and proceed to the mouth of Bloodvein river. Although darkness had set in before this was reached, the trip was made without incident and the party was accommodated that night and until the following Monday morning in the warehouse of the Hudson's Bay Company. Here a guide was obtained to pilot the party up the river to Artery lake and a start up the river was made on Monday morning. It was indeed fortunate that no delay had been allowed at Matheson island, for both on Sunday and on Monday winds were blowing so hard that no crossing of the lake could have been attempted in the canoes that were at the disposal of the party.

To require a guide in order to ascend a river, does to all appearances appear to be unnecessary. However from what had been seen of some of the lakes at the headwaters of Bloodvein river, along the line the previous autumn, coupled

with advice that had been received from those acquainted with the river, this was the only safe course to follow. The trip had not lasted very long before the absolute necessity of the guide was readily apparent and it was due to his services that the ascent of this river was accomplished in six days and that the party joined Mr. Davidson and the cache keeper at the south end of Artery lake the following Saturday evening. Here they had camp set up and everything in readiness for an immediate start on the line, the end of which was about three miles south.

By referring to a map of this district it will be seen that Bloodvein river is mapped as far as Sasaginnigak lake, this lake having two outlets with the river. A short distance down the river from here, at Kautunigan lake, a south branch enters, but beyond indicating the probable direction from which this branch originates, no further information is shown on the map. The origin of the information shown is from Geological track surveys. From information that had been obtained it was known that this south branch of Bloodvein river that joins the north branch in Kautunigan lake, is, farther up, again divided into two rivers, the south branch draining Obukowin and Carroll lakes, these being referred to in the report of the previous year, while the northern branch comes from Artery lake. Below Kautunigan lake, although there are numerous falls, rapids, and other obstructions to navigation, including several cases of the "circle river" there is very little possibility of getting off the route. Portages are, however, frequent and not very plainly marked so that the guide was of great assistance in his being able to indicate just what rapids canoes might be drawn up with ropes and on which side they should be followed, or, if a portage was necessary, where the landing was. The landing was seldom apparent to the newcomer. Although it was assumed that the guide would lead the party up the south branch of Bloodvein river from Kautunigan lake to its junction with the centre branch from Artery lake and then up that branch to that lake, he did not however follow this route, due to there being too much bad water when ascending the river.

Transport Route, 1922

During 1922 the route was by way of Sasaginnigak lake to Artery lake, and then, following a small creek at the extreme north end of Artery lake for a half mile a lake about 60 chains long was entered. From the north end of this lake by a 50-chain portage, a small lake about a mile in length and lying nearly east and west was reached. Crossing to the north side of this lake a 20-chain portage was made northwesterly to another small lake. From this lake a small creek that may be navigated in high water was followed northwesterly, crossing the line at mile 140, and continuing for two miles to a big bend, from which point a portage nearly two miles long was made northwesterly to the east end of lake No. 7. At the northeast corner of this lake a 10-chain portage was made to the south end of Walker lake. At the northeast corner of this lake a lift over was made to lake No. 11 and from here a 25-chain portage at its north end was opened out directly to Hobbs lake, nearly a mile east of where the line crosses. The

route left the north side of Hobbs lake from a bay nearly three miles east of the boundary, where after crossing a 5-chain portage an irregular lake extending about a mile northeast was entered. At its easterly end a 19-chain portage was made to a small pond from which a 23-chain portage led north into the south end of another lake about a mile in length. On reaching the north end of this lake and crossing an 8-chain portage the southwestern arm of a much larger lake extending considerably to the east was entered. About a mile up the west side of this arm a 17-chain portage almost due west was made into the south end of Irwin lake. On leaving Irwin lake the route followed Irwin creek through to Clayton lake. On reaching Clayton lake a water system was entered, which as a result of the winter exploration was known to provide a satisfactory route remarkably free from obstructions to navigation for the next 40 miles. From Clayton lake the route was through Dogskin and Family lakes to Moar lake. From Moar lake the transport returned to Little Grand Rapids and followed

Visit of Hydroplane to the Survey Party

The Royal Canadian Air Force, brought in mail to the party and co-operated as far as possible with the survey. On this occasion they were leaving camp with the Controller of Surveys, of the Department of the Interior, who had made a trip of inspection to the work.

the Deer lake route which led through Fishing lake to Bradburn lake. From Bradburn lake the route followed along Bradburn river through Disbrowe and Rheaume lakes. Then by following one of the tributaries of Poplar river northwesterly Sparrow-hawk lake was reached. From Sparrow-hawk lake a small creek followed to lake No. 60, and from the north end of this lake a 90-chain portage was made to Assapan lake, and from here the route lay through Marila, Meandrine, McKay, and Perreault lakes to Palsen lake near the northern extremity of the line.

Inspection

Shortly after supper on Monday, July 3, while headquarters were located on Clayton lake, a hydroplane was first heard and then seen approaching from the south along the line. Immediately dense clouds of smoke were started around camp to attract their attention as the camp was on the lake shore some

distance from the line. This would have been effective had it been necessary, but it was afterwards ascertained that the white tents of the camp and some of the bright cooking utensils reflecting the light had already attracted the attention of those on board and the hydroplane after circling around the lake finally descended into the water in front of camp. Mr. A. M. Narraway, Controller of Surveys, was on board and had chosen this method of making his trip of inspection to this boundary survey. He had left Winnipeg that same day, and after having supper at the Air Station at Victoria Beach had reached the survey camp in about an hour of flying. Mail that had accumulated at the Air Station for over six weeks from the commencement of operations was brought in to the party on this trip. The plane returned to Victoria Beach the following day and on Friday, July 7, it came back to camp to take Mr. Narraway away, he having in the meantime completed his inspection of all the details of the survey and organization.

Arrival at Twelfth Base Line

The twelfth base line was reached on October 6 and all operations of the survey were brought to completion that day or early the following morning and an immediate return to lake Winnipeg via Little Grand Rapids and Berens river was commenced. The route followed to Little Grand Rapids was back along the transport route along the line to the Deer Lake route and Little Grand Rapids was reached the following Saturday October 14. Snow had already fallen before the party reached this point. The following Monday morning the party left Little Grand Rapids, following Berens river and they reached the mouth of this river on the following Friday. On September 12, a request had been sent from the field to the Northern Fish Co. at Selkirk, which operates boats on lake Winnipeg to meet the survey party at this point on October 22, and it was now the 20th of October. This date had been selected 6 weeks earlier after a most careful estimation of the amount of work remaining to be completed had been made and it was a source of extreme satisfaction to all the members of the party to find that now, as a result of their continued faithful and diligent service throughout the season, no adverse weather had prevented their reaching lake Winnipeg for this date. Snow again fell while the party was coming down Berens river and many of the bays with shallow water froze over. Though this made the trip somewhat difficult and at times, unpleasant, no one paid any attention to these now very minor considerations and they did not cause any appreciable delay.

Towards evening on the day following the arrival of the party at lake Winnipeg, the boat that was to connect with them here arrived and proceeded the following morning with the party to Selkirk. This was reached on Monday October 23 and the party was discharged the same day. The captain of the boat had on this, the final trip of the season, been first to Norway House at the north end of the lake before he came to the survey party. He expected to have been at Berens river two days earlier, in which case he would have been there

LOOKING SOUTH FROM THE END OF THE LINE AT THE TWELFTH BASE

The construction of the final monument of the survey is in progress on rock outcrop in the horizon

FINAL MONUMENT OF THE SURVEY

Stone Monument No. 219 at 238 miles 4·1009 chains north of the Northwest Point, elevation 1048·8 feet, erected to witness position of the twelfth base line

ahead of the party, but he was frozen in at Norway House and lost two days breaking out through the ice.

In conclusion while reference has already been made to the attitude that the rank and file of the organization displayed throughout the season towards the survey, it is fitting that notice should here be made of the ability and untiring energy that was at all times devoted to the work by the members of the staff. These were Messrs. R. D. Davidson, D.L.S., senior assistant, John Carroll, D.L.S., assistant, and G. Palsen, leveller, junior assistant. The services of these gentlemen were continually concentrated on the successful performance

The Return of the Survey Party Down Berens River

About six weeks previous, arrangements had been made for a steamer to connect with the party on lake Winnipeg. As snow had fallen and the calm water was freezing over, there was considerable anxiety throughout the party in regard to the connection.

of the survey and their work cannot be measured in hours for without their loyal support the successful conclusion of the survey would not have been possible.

Summary of 1922 Operations

The following is a summary of the results of the season's operations:—

Miles of line surveyed	111
Miles of stadia traverse	750
Miles of track surveys	160
Monuments erected	86
Magnetic observations	105
Astronomic observations	115

CHAPTER V

GENERAL DESCRIPTION OF THE DISTRICT

An Unknown Section

The district through which the meridian section of the Ontario-Manitoba boundary passes is one that is, as yet, generally unknown and unexplored. This is mainly due to the fact that there are no agricultural lands to attract settlement, and up to the present, there has been no discovery of valuable minerals, aside from those in the Rice Lake Mining district, of sufficient importance to bring any number of prospectors or miners to the district.

Falls on Bloodvein River
Eight-foot fall below Minago creek

While other areas considerably more remote from our centres of settlement are served by a network of rivers that afford convenient access to or through them and are on that account comparatively well known, this district, notwithstanding its relative proximity to lake Winnipeg, possesses no water routes by which it may be readily visited. True, there is a series of waters intersecting the area, that all drain to lake Winnipeg but navigation along these waters is extremely difficult, arduous, and even dangerous to any one not familiar with

the local peculiarities of transportation. On the most used rivers, rapids, falls, and shallow water follow each other in rapid succession, requiring the constant loading, unloading, and carrying of freight and canoes over such portages as have been cleared out. While distances here are not great, when measured in miles, it has never been the custom in this district to use the mile as a standard of measure. The length or duration of a trip is ordinarily referred to as so many nights or sleeps; or when travelling along rivers, the distance is referred to in terms of the number of portages encountered. From this information the prospective traveller may determine the probable length and duration of the trip he has in view, assuming that he can negotiate portages and run or ascend rapids with facility equal to that of the native and that he is prepared to travel from daybreak to sunset.

By reference to the general map of the district it will be noted that a considerable portion of the southern part of the line is only about 50 miles east of lake Winnipeg. Towards the north, the lake bears off to the west and at the twelfth base line it is about 100 miles from the line. The entire area intersected by the line is drained by a succession of rivers all flowing to this lake. The most important and best known of these is Winnipeg river which crosses the line at the point of commencement of the operations of 1921. This river is one of the principal sources of lake Winnipeg and it is of great historical interest. This dates back to the time when fur-trading was the only industry in the northern part of Canada and this was the main route connecting Western Canada with the east. Before the amalgamation of the North West Company with the Hudson's Bay Company the former company forwarded all provisions and trading supplies to Western Canada from their headquarters at Montreal and brought back the fur that had been received as barter through this route. The main distributing point for the west was then Fort Garry, where the city of Winnipeg now stands.

Up to this time the main depots of the Hudson's Bay Company had been situated on Hudson bay and these were supplied once or twice a year with shipments direct from Europe. After the amalgamation of the two companies, now known as the Hudson's Bay Company, the importance of the depots on Hudson bay gradually waned and more and more supplies were brought through Winnipeg river from Eastern Canada. This was due to the progress of settlement and commercial development in Eastern Canada that enabled the east to partially produce and supply the merchandise required for the western fur-trade. This marked the commencement of the period of the greatest transport activity that Winnipeg river had ever experienced and this lasted until the completion of the Canadian Pacific railway, when the use of this river as a route was terminated, transport thereafter being by rail.

At the mouth of the river on lake Winnipeg, the now unimportant trading post of Fort Alexander is located. During this period of activity this post was, on account of its strategic position for the distribution of goods either north or south on the lake, one of the most important depots of the district, even rivalling

Fort Garry at times. It was at that time the main distributing point for Western Canada, though Fort Garry was the executive and commercial centre. Large warehouses for the storage of merchandise, quarters for the accommodation of the officers and servants of the Company, store houses, and factories for the building of York boats were located here. It was at the same time the head of both lake and river navigation and it was visited by all having occasion to travel between the east and west during that period.

Governor Simpson for years passed through here from Montreal when on his trips of inspection to the trading posts of the west. Sir John Franklin passed down this river in 1825 en route for the Arctic and again ascended the river on his return two years later. During his visit at Fort Alexander he made a determination of the magnetic declination, the results of which are available in the tables of magnetic declination for points in Canada that are periodically published. Those veteran explorers and surveyors of the Hudson's Bay Company, Sir Alexander Mackenzie and David Thompson repeatedly travelled this river between 1790 and 1800 and refer to it in accounts of their voyages.

With the advent of rail transportation, the settlement of much of the adjoining district, lumbering operations in the vicinity, and huge developments of water power at Pointe du Bois and Lac du Bonnet the importance of Fort Alexander has vanished. An Indian reserve has been laid out at this point and there is at present a considerable number of Indians who live here and gain a livelihood from fishing and hunting in the adjoining district, farming or doing any general labour if such happens to be required at the time that they are in need of pecuniary employment. With the exception of a store and dwelling now belonging to the Hudson's Bay Company all visible evidence of the extensive buildings once here is gone. The river itself is now little used for navigation, except by the local Indians when travelling to or from their hunting grounds or by occasional tourists who find the canoe trip between lake of the Woods and lake Winnipeg both interesting and very convenient to make.

Water Systems

To the north of Winnipeg river the more important rivers crossed by the line were Oiseau river, a tributary of Winnipeg river, Manigotagan river, Wanipigow river, Bloodvein river, which had however broken up into three separate tributaries before the line crossed them, Pigeon and Berens river systems, and three main tributaries of Poplar river.

All of these rivers are much smaller than Winnipeg river and with the exception of Berens river, do not extend very far beyond the boundary into the province of Ontario. The elevation of lake Winnipeg is about 710 feet above sea level while the elevations of these waters where they cross the boundary is usually between 1000 and 1050 feet; so that these waters all have a fall of about 300 feet before reaching their outlet. This does not occur at any one point but is made up of a succession of small drops generally under 10 feet at a

time through the entire extent of the rivers. In the case of some of the rivers, there are a few miles near the mouth where these obstructions are not so numerous as they are in the interior.

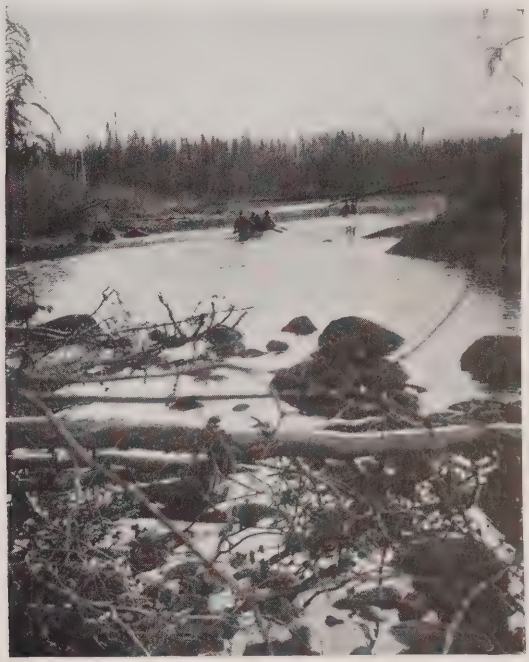
The information obtained from those best acquainted with these rivers is that there are the same number of portages on each river for an equal distance back from the lake. This appears to tally fairly well with information gained during the survey. There are 52 portages below Little Grand Rapids on Berens river, practically the same number on Pigeon river and 51 on the Bloodvein to Artery lake.

Aside from obstruction to navigation due to falls and rapids, there is another characteristic, typical of rivers in this district, that presents even more difficulty to their navigation by other than those familiar with the route. This consists of the numerous irregular and often extensive lakes through which these rivers repeatedly pass and the continual occurrence of what are locally known as "circle rivers." Usually, the lower portions of the rivers are confined to one channel and though obstructions may be frequent, the course to be followed is not in doubt. When the lake region is reached there is constant perplexity as to where the route leaves the lake. Bays, inlets, and channels between islands simultaneously present themselves and offer further progress to the traveller with equal apparent possibility of each leading to the desired outlet. It is only by tediously investigating one after the other of the possible alternatives offered that the route is ultimately found. It is in this lake region that the rivers quite frequently break up into tributaries and where these join in the same lake, a further source of trouble is encountered. "Circle river" is the local term applied to this characteristic class of rivers, which divide into what appear to be two distinct rivers, only to reunite farther down. The area enclosed is of course an island, but this is often so extensive, while the water surrounding it is in places so negligible, that quite a stretch of imagination is required before the mind finally decides to accept it as an island. By reference to the general map of the district, three or four examples of this condition are shown, the most notable being that of Berens and Pigeon rivers which have a common origin in Family lake and a common outlet in lake Winnipeg. Further down Berens river from Family lake, Etomami river is another example of a circle river. A third is shown at Sasaginnigak lake, where its two outlets unite to form the north branch of Bloodvein river. Many other cases were found during the survey on these and other rivers. Cases of there being three distinct channels of the same river were noted.

Navigation of a river here necessitates either a guide, or that there be sufficient time for the investigation of the alternative routes. This latter is tedious and for the most part unsatisfactory, but as guides are occasionally unprocurable this is often the only alternative. Where cross country travelling is necessary, such as was the case during the survey, it was found that although the natives were very familiar with certain areas through which they ordinarily hunted and were on that account extremely valuable while the line was passing

the locality, yet once out of that district they were hopelessly at sea. Unless they could be replaced by others familiar with the next area, this work fell to the head packers and explorers of the party as was usually the case.

To a great degree this trouble in regard to the position of routes would not occur if even approximate maps of the district were available. Winnipeg river has of course been surveyed in connection with the power developments and this is now accurately shown on all maps of the district. The only other water system that is indicated at all in the vicinity of the line, on maps up to the present, is that of Berens and Pigeon rivers. These rivers were originally



"Circle River" Near God's Lake on Berens River

Streams in this district frequently separate into two or more distinct channels, which unite lower down. The enclosed area is really an island thus giving rise to the term "circle."

roughly surveyed and mapped by geologists who years ago continued their investigation from lake Winnipeg beyond the boundary line into the province of Ontario. Subsequently in the course of investigation of these rivers for power possibilities by the Dominion Water Power Branch of the Department of the Interior, much additional detail was added to the existing information so that the maps of these rivers below Little Grand Rapids are fairly approximate. Of the other rivers crossed by the line, no survey or even a sketch bearing any relation to their actual position, has ever been made of their upper waters in the vicinity of the boundary.

During the period of transport activity along Winnipeg river prior to the construction of railways, fur-trading was the sole important resource not only of this district, but through the greater part of Northern and Western Canada. The natives then lived permanently in numerous small villages and hamlets scattered throughout the entire district. At Snowshoe, Garner, Hobbs, Clayton, and Dogskin lakes and at many of the larger lakes near the line, families have at one time lived permanently, where now there is no settlement except for a short period during the hunting season. There are many of the older men now living on the various reserves of the district who were born and lived during their youth in these now outlying points. At that time trading posts were distributed much more frequently than they now are, while along practically all the rivers are yet to be found evidences of their having been, at that time, extensively used as canoe routes.

The establishment of Indian reserves, the advent of steamboat transportation on lake Winnipeg together with the development of the fish industry on this and other of the more accessible waters has resulted in the withdrawal of the natives from their scattered homes and their congregating in compact settlements on Indian reserves. These are for the most part situated on lake Winnipeg at the mouth of the various rivers, although there are four inland settlements. These are Little Grand Rapids on Family lake, a lake expansion of Berens river, and Island lake, both in the province of Manitoba; Pikangikum, farther up on Berens river, and Deer lake on the head waters of Severn river, both being in the province of Ontario.

The occupation of the natives resident along lake Winnipeg has undergone a substantial alteration from that of hunting, which was formerly their sole employment. Fishing is now one of their staple industries and only a few of them engage in trapping and hunting, generally up the rivers on which they are living in the old hunting ground of their parents. As hunting is confined chiefly to the winter months, when transport is by means of dogs, the summer water routes have greatly fallen into disuse and portages are grown over and filled up. This accounts in part for the difficulty now incident to summer travel through the greater part of the waters.

On practically all the reserves along lake Winnipeg, trading posts, some operated by the Hudson's Bay Company and others by private traders, fishing stations, and freezers are now in operation. Many of these are closed up during certain seasons of the year depending on the local requirements, but at Fort Alexander, Manigotagan, Bloodvein River and Berens River, well stocked stores are open the year round. With the development of the fishing industry and the ready transportation on the lake, necessary for the marketing of fish during the summer, many whites have also settled in the vicinity of these reserves and have to a great degree intermarried with the natives, so that now along the lake, half-breeds predominate in point of number. Schools have been opened up and missions, both Roman Catholic and Protestant, are actively operated while mails are regularly received. Although the Indian language

is still in general use among the half-breeds and natives, English is usually understood.

While of the settlements mentioned, Berens River is the most important, this is not solely because the reserve here is larger than the others. Its importance is materially influenced by the fact that Berens River is the distributing point for three of the four inland settlements previously referred to, viz.: Little Grand Rapids, Deer lake, and Pikangikum. The first of these settlements to be approached after leaving Berens River post is Little Grand Rapids about 90 miles up Berens river on Family lake, about 15 miles west of the boundary.

Little Grand Rapids owes its name to a spectacular 20-foot falls on Berens river about half a mile north of where it enters Family lake in close proximity to the trading posts. An Indian reserve has been surveyed out for the natives of this district but so far very few of them have taken up residence on it. During the summer season they prefer to live in tents or tepees near the various trading

THE HUDSON'S BAY COMPANY TRADING POST AT BERENS RIVER, MANITOBA
In addition to local trade, this post is a distributing point for supplies for three inland posts up Berens river

posts, of which there are at present three in number, or in a couple of smaller outlying settlements not far from the main settlement. One of these is on an island near the northern end of Fishing lake, while the other is on Moar lake about 12 miles to the east of Little Grand Rapids. These natives are far superior as hunters to those along lake Winnipeg and during the season they travel in all directions from the post to their hunting grounds where they and their families temporarily live during the winter.

The natives here as well as those farther inland have not been diverted by other occupations from hunting, trapping, or freighting, and these are the sole industries of the district. The usual fur-bearing animals common to the district include muskrat, beaver, fisher, marten, mink, ermine, fox, and bear. The quality and quantity of the furs of these are such that these posts are among the most valuable of any operated by the Hudson's Bay Company through both Northern Ontario and Manitoba. The fur-trade of posts along lake Winnipeg is much inferior to those of the inland points.

During the summer months, the chief occupation of the natives is freighting in supplies from Berens river and forwarding them to Deer lake and Pikangikum. In an average season the Hudson's Bay Company alone brings about 80 tons of freight to this point, of which 40 tons is forwarded on. The two other posts here are operated by independent traders, one by a Mr. Blundel and the other by the firm of Mackay and Whiteway who have their headquarters at Berens river and other posts both at Pikangikum and Deer lake. Both of these posts do an important business so that probably the total amount of freight brought up Berens river would be double that mentioned or 160 tons per season.

Cargoes are frequently lost by canoes sinking or capsizing in these rough waters and this in addition to the abnormal depreciation on canoes and the excessive damage suffered by goods due to such constant handling and mishandling, brings the final cost of goods landed at Little Grand Rapids con-

Native Dwellings at Little Grand Rapids

siderably above the six cents per pound actually paid to the freighters; 10 cents per pound may be considered the usual cost of freight over this river under these conditions of freighting.

Ten cents a pound appears to be a fabulous price to pay for freight carried only about 70 miles in a straight line and it is curious that a cheaper method of transport has not been inaugurated before this. A winter road could readily be cut from Little Grand Rapids to Berens River or across country through Fishing lake and Sasaginnigak lake to Manigotagan settlement reaching lake Winnipeg in about the same distance, over which the annual freighting of 160 tons might be accomplished at a considerably reduced cost.

Educational Facilities

The natives living at Little Grand Rapids, and as far as could be ascertained those at Deer lake and Pikangikum are in the same condition, have so far received none of the advantages or disadvantages of civilization or religion, as have those living along lake Winnipeg. They are all full blooded Indians, and English or any language other than Indian is unknown to any of them. The only whites in the district are the officials of the trading companies and their families.

Education is non-existent although during the past season an attempt was made to form a school during the summer months. A school master was sent in and for a short time there was an attendance of about fifteen children. The nomadic nature of the inhabitants prevented the most of the children from

Native Teacher and School Children at Little Grand Rapids

A school was started here years ago but was shortly after abandoned. In 1922 the school was revived during the summer months, though it terminated with the opening of the hunting season

attending school with anything like regularity and towards fall all the people had moved away to winter quarters on their hunting grounds, taking the children with them. The attendance then was confined to the children of the trading post managers. Only a faint smattering of religious observances has entered the minds of these people. They have from some source received an idea of the sanctity of the Sabbath day, sufficient to prevent them from leaving their homes to start a trip on that day, although they will not delay a trip that they are already engaged on by the coming of the Sabbath. A superstitious belief in the power of sorcery and the very real presence of evil spirits actuates and

controls many of their movements. This is believed in to such an extent that very few will undertake a trip alone, especially after dark and certainly none would dare to camp or sleep alone over night.

Dwellings are for the most part tepees or tents although there are a few shacks in the neighbourhood of Little Grand Rapids and at the settlement on an island at the north end of Fishing lake. Beyond a very few potatoes that are grown in the garden at the Hudson's Bay Company's post and a couple of extremely small patches belonging to the Indians no attempt whatever is made at cultivation. Disregarding dogs, there are no domestic animals in the district except that the Hudson's Bay Company's manager has a very ancient steer which was brought in over the ice from Berens River some years ago.

Deer Lake Trade Route

About half of the freight that reaches Little Grand Rapids is in turn forwarded to the two farther inland posts at Pikangikum and Deer lake, this latter post receiving the greater quantity. The route to Deer lake follows a general northeasterly direction from Little Grand Rapids, through Fishing lake and then through a chain of small lakes, creeks and portages across the headwaters of Poplar river and finally over the height of land between the waters flowing to Hudson Bay and lake Winnipeg until ultimately Deer lake is reached. Deer lake forms part of the headwaters of Severn river and the post is situated on this lake about a day's paddle from where it is first entered.

A striking contrast in the condition of the portages between Berens river and Little Grand Rapids and of those between Little Grand Rapids and Deer lake is very noticeable. Though many times more freight is handled over the route below Little Grand Rapids than there is on the route above, it is handled by several companies, each of which leaves to the other as far as possible, all improvements of the portages. The result is that nothing is done beyond what is absolutely necessary to make the particular trip one is engaged on, and the condition of the portages is such that they are only just passable. On the route from Little Grand Rapids, leading to Deer lake, until very recently all freighting has been in the hands of the Hudson's Bay Company and a great amount of labour has been expended in improving portages. Crossings over wet places and swamps have been made, steps erected up steep inclines, landings constructed and the portages themselves well cleared out. Between Fishing lake which drains through Berens river, and Disbrowe lake which is drained by Poplar river, alternative routes are used in summer freighting. Of these, the more southerly route through Bradburn lake is shown on published maps. The other route leaves from the extreme north end of Fishing lake and passes through the usual chain of creeks, portages and small lakes, crossing the boundary through a lake about four miles north of Bradburn lake and finally joins the first mentioned route at the portage leading to Disbrowe lake. This route is more direct than the other and except in the very lowest water is the one generally used.

Freight charges on goods to Deer lake are very high and the ordinary selling price of flour at that point is $40 per cwt. At Little Grand Rapids it is $20. A few years ago the Hudson's Bay Company made an investigation of an alternative route from lake Winnipeg to Deer lake through Poplar river. While this route is much more direct than the one now used around by Little Grand Rapids and from information furnished by Chief Wm. Berens of Berens River Indian reserve, who conducted the investigation, the portages are fewer in number, it has not yet been opened for use. This may be due to the fact that supply depots and a forwarding organization is already in operation at the mouth of Berens river while there is nothing at all at the mouth of Poplar river, not even a regular boat landing. Then too, supplies for Little Grand Rapids and Pikangikum would still have to come up Berens river. Chief Berens prepared a sketch map of this investigation of Poplar river which permitted the identification of one of the branches of the river when the boundary line reached it.

All the district in the vicinity of the boundary between Winnipeg river and Hobbs lake is the hunting ground of Indians from lake Winnipeg, chiefly from Fort Alexander, Manigotagan and Bloodvein reserves. To the north of Hobbs lake and until Marila lake is reached, the line passed through hunting grounds of Little Grand Rapids Indians. From here to the twelfth base line, the line for a distance cut across a corner of the Deer Lake Indians' grounds and finally ran into the grounds of Island Lake Indians. While to the layman there is little or no visible evidence on the ground to indicate the borders of these hunting areas, they are quite clearly defined in the eyes of the native and encroachments or disputes over boundaries are by no means as common here as they are between landholders in surveyed settled districts.

Natural Hunting Grounds

During the winter season, when the waters are frozen over and the snow is on the ground, the restrictions to travel, due to the surface character of the country are to a great extent removed. Travel in all directions then becomes convenient and there is continual intercourse between the hunters who are resident at all points of the area. Dogs are used exclusively both for travelling and for freighting, although the traders do not as a rule attempt to freight large quantities to any great distance by this method. They are, however, constantly engaged in what is locally known as "tripping," whereby small loads of goods and merchandise are taken by dog train to the hunters on their own grounds and are there bartered for fur.

The natives along the lake usually put up sufficient fish during the fall to feed their dogs through the winter, but inland, although fish may readily be procured, very few are ordinarily put up by the natives for the use of their own dogs. The traders however require considerable quantities for their tripping and freighting which the natives procure. The natives' dogs are not usually

very constantly employed and are ordinarily fed on the products of the trap line, snare, or rifle.

Surface Characteristics

The general surface characteristics of the country undergo a radical change as the district through which the boundary line passed is approached from lake Winnipeg. Along the lake and extending from 20 to 30 miles back from it, there is a belt of nearly flat country in which large muskegs and extensive swamps occupy the major part of the surface. Very few lakes occur in this area. While narrow strips of relatively high dry land are to be found along the banks of streams on which there is a good growth of spruce, jackpine, poplar, and birch, some of which is of commercial value, the timber generally is the scrub spruce variety that is found in the muskegs and which is of little account. Rock outcrops are very prevalent along the watercourses, while at intervals through the muskegs outcrops will occur resembling islands in appearance. Where

Surface South of Snowshoe Lake Near Mile 74
Note the even sky line, low relief and preponderance of rock at the surface

there is any soil on these outcrops, the timber is usually jackpine. Generally speaking this belt of territory is a wet marshy country, but little higher than the elevation of lake Winnipeg and it has little to offer in the nature of resources beyond the commercial timber that is so favourably situated along the watercourses.

After crossing this belt, lakes begin to appear and rock outcrops become more numerous, until long before the boundary is reached the surface has become a network of lakes, rivers, and streams with only a few small local marshes, swamps, or muskegs, all separated by numerous irregular and often extensive outcrops of massive bedrock. As far as was observed or could be ascertained, this condition extends to a very considerable distance into the province of Ontario. The general elevation of the country in the vicinity of the line is now from 300 to 500 feet above the level of lake Winnipeg, although local varia-

tions of elevation seldom exceed 100 feet. As the height of land separating the country draining towards lake Winnipeg from that draining elsewhere, is at all points farther east in the province of Ontario the maximum elevations of the district were not observed. The surface, when viewed from the air or from a distance appears flat and without relief as there are no points of outstanding elevation, or of high altitude such as is common in other districts. The extremely broken irregular nature of the surface, when investigated more intimately, soon becomes apparent and so complex is this maze of ridge, valley, fissure, precipice, or water that there is little uniformity to any topographical detail of the district. Travel across country in any direction cannot be accomplished without great difficulty and water routes with their incident obstructions to navigation already referred to, present the only means of travel through the country during the summer.

Soil

Soil is, generally speaking, non-existent. The ridges and summits are usually bare bed rock with sand and boulder filled fissures and crevices, these being usually moss covered. The valleys are made up of a litter of boulders and broken rock that has come from the adjoining hills, through which sand, gravel, muck, or vegetable decomposition is often freely distributed. The lower of these valleys are covered with water and constitute the numerous water areas of the district. As would be expected the surface of these lakes is broken by boulders, rocks, or islands which, with numerous others just below the surface, render their navigation a matter of constant care and anxiety. The remaining valleys, depending upon the amount of saturation present, constitute muskegs, marshes, or swamps. In muskegs, the rock and boulder surface has been covered by water saturated muck, this being in turn covered by a deep growth of moss which supports a growth of stunted spruce and tamarack. As rock is seldom far below the surface the muskegs of this area are comparatively solid at bottom and very few of the trembling type occur. Swamps are usually moss covered at the surface while underneath owing to the lessened amount of moisture the soil is a more solid mass of muck, sand, and boulders. Many of these swamps furnish a good quality and an extensive supply of merchantable spruce and tamarack. Occurring somewhat less frequently than either swamps, muskegs, or water areas, some of the valleys were found to be filled to a considerable depth with sand so that they resembled minature sand plains. Here the timber cover is jackpine of good quality.

Between the valleys and the summits of ridges and along the immediate banks of water, the more or less oblique interval presents a rough boulder strewn surface with frequent outcroppings of bed rock. Through this is mixed a sufficient quantity of sand and vegetable decomposition to support a surprisingly vigorous and extensive growth of mixed timber consisting of spruce, jackpine, poplar, birch, and occasional balsam. On the uplands, on account of the prevalence of exposed rock at the surface, the cover is stunted jackpine of no commercial value.

Occasionally, particularly along streams, silt, sand, and muck have been so mingled as to produce fairly good soil and a luxuriant growth of grass with alder and willow brush occurs. Boulders and rocks are however ever present and these areas are so small as to be of no value for agricultural purposes. Soil suitable for agriculture is not found anywhere through this district, while the surface, even if suitable soil were present, is much too rough and broken for farming. Grazing lands, also, do not occur. By carefully gathering all the hay to be found in small quantities through the district for miles around, it is possible at some points to obtain sufficient feed for the sustenance of one animal as is now done in the case of the locally famous steer at Little Grand Rapids. This, however, may be taken as an indication of the extent of available feed the district offers.

A similar condition applies to soil. The garden at Little Grand Rapids has been in use for possibly a hundred years. At any rate, the father of the present manager who is over 50 years of age and was born here, was manager of this post and this garden was in use before he came here over 60 years ago. The garden is not a natural one, as it has been largely made from soil brought in from other places and this is continually being replenished. As time goes on agriculture or any allied industry can with great certainty never feature as a resource of this entire district.

Forest Cover

While the fur trade has to within recent years been the only resource of the country, there are possibilities in regard to commercial timber. This consists mainly of spruce and jackpine, although in some districts considerable quantities of poplar and birch of merchantable proportions occur. The largest and best of this timber is usually found along the rivers and lakes, and up the draws leading to them, thus resulting in the major part of the timber being comparatively convenient of access. Throughout the entire area, except on the bare rock ridges which are of appreciable extent or through muskegs, the surface supports a vigorous growth of merchantable timber. The extent of this is enormous and though a great part of it is not large enough for sawing timber, it is suited for pulp wood. At the extreme northern end of the line, miles of spruce and jackpine up to 8 inches in diameter were passed through. This was interrupted of course by the intervening waters, muskegs, and rock ridges.

Unfortunately, repeated forest fires have from year to year continually destroyed much of this valuable timber so that to-day probably two-thirds of the entire area has been devastated. The result is that now mile after mile is a barren desolate waste. All vegetation, including the vegetable decomposition that has been the product of centuries of contribution and which is the essential requirement for further vegetation on this scanty soil, has been entirely destroyed and gleaming rocks piled high with charred timber stretch as far as the eye can see. At other points, where much of the present timber has been destroyed, fire has not so completely removed the possibility of the area being in time

reforested. Second growth timber is now springing up and some of this is already large enough for pulp wood.

Large and entensive areas of timber through the entire district from Sparrow-hawk lake to Meandrine lake and in fact right through as far as the line ran, have been completely destroyed by fire. Probably only 30 per cent of the original timber remains undamaged and a great deal of this is so scattered about in such small quantities as to be of little value. There are, however, in some localities chiefly along the water areas some fine jackpine and spruce of merchantable dimensions which on account of their accessibility are valuable. Through the final 10 miles of the line, the country is particularly well covered with spruce and pine, much of which is 12 inches in diameter. Here the fire was not quite so severe and only lightly touched the timber in places, so that there is

Disastrous Effects of Forest Fire

District north of Moar lake, near Mile 184, where nearly all of the original timber and surface soil has been destroyed

yet considerable valuable timber remaining. At the end of the line, however, a completely burned area was entered and the country for miles ahead appeared to be almost bare.

Fires, such as have occurred here are more destructive, if that is possible, than they are in other districts that possess a more favourable climate and a more productive soil. Here the forest is the only possible production of the soil and its annual growth is, on account of unfavourable climatic conditions much less rapid than obtains elsewhere. Besides doing damage to the timber and vegetation there is another immediate result of fire that is in the opinion of the natives, the most serious of all. Game almost completely disappears from these destroyed areas. Fire is, therefore, the most serious calamity that can overtake this district.

A cursory examination of the district in the vicinity of the line indicates that considerable valuable timber is yet to be found through the area between

Winnipeg river and Shinewater lake, a distance of about 10 miles along the line. Between this point and Snowshoe lake about 10 miles farther in, the line passed through a burnt area in which at some points all timber and vegetation has been destroyed. Beyond Snowshoe lake and reaching to the vicinity of Hobbs lake, a distance of about 65 miles, the line constantly passed through valuable timber that has only been locally damaged by isolated fires of small extent. To the west of this section, in Rice Lake Mining district a considerable area has been

VALUABLE TIMBER UNDAMAGED BY FIRES
Spruce and jackpine timber in the vicinity of Obukowin lake near Mile 115

burned over, and two narrow tongues of this burnt area reached the line between Garner and Carroll lakes. Along one of the branches of Bloodvein river, which crosses the line here through Artery lake some timber has been destroyed in the immediate vicinity of the river. For the next ten miles, on to the district of Dogskin and Clayton lakes the original timber has been entirely destroyed though this is now being rapidly reforested with an extremely dense stand of second growth jackpine and spruce. This dense growth that is springing up

from a surface already piled high with fallen burnt timber results in an almost impenetrable obstruction to travel.

Between Clayton lake and Moar lake a distance of roughly 20 miles, fire has repeatedly visited considerable areas, chiefly the uplands. Spruce in the swamps has generally escaped damage but except in the immediate vicinity of water, jackpine has been extensively damaged. Commencing a short distance to the north of Moar lake, the line then passed through 6 or 7 miles in which everything had been destroyed, while from there to the end of the survey practically the entire area has been overrun by fire. Probably two-thirds of the timber is

Burnt District Now Being Reforested
Vigorous growth of jackpine and spruce near Hamilton lake, Mile 204, where nearly all the original timber had been destroyed

here destroyed though the line constantly passed through small patches of valuable standing forest.

By summarising the foregoing, it is evident that of the 180 miles of territory intimately examined, roughly 75 miles is practically virgin forest, about the same quantity has been seriously damaged, though there yet remains timber of appreciable value, while on the remaining 30 miles all timber and most of the vegetation has been completely destroyed. So far as it was possible to observe, these figures approximately indicate the relative proportions of these types of forest conditions throughout the district.

Beyond the negligible amount of timber required for local use, no lumbering operations have been carried on in the vicinity of the boundary line. To a limited degree, lumbering has been extended through the district adjoining Winnipeg river in Manitoba and at one point operations were noticed near Ryerson lake in the immediate vicinity of the line. A sawmill owned by J. D. McArthur has been in operation at Lac du Bonnet on this river. To the east of this section, in the province of Ontario operations are only just reaching this latitude, though much of the timber lands have been laid out in limits and are already disposed of. Along the Manigotagan and Wanipigow rivers active operations, though on a small scale, are now under way and considerable timber is being brought down these rivers to lake Winnipeg. As there is yet sufficient merchantable timber in closer proximity to transportation to meet present needs, general lumbering operations have not, as yet, been extended to this district. As the more readily available supply becomes exhausted the timber resources of this district must in turn be utilized in order to meet the constantly increasing demand for timber and pulp wood.

Potential Fishing Industry

Aside from the demonstrated importance of the fur trade and the potential value of its forest, there is another resource of this district that has, up to the present, been entirely undeveloped. This consists of the fishing industry. This industry is carried on extensively on lake Winnipeg which furnishes ready transportation to the markets and it is also being carried on successfully in the smaller lakes of districts identical to this one at points farther east in the province of Ontario that are within convenient access to the railroads. On lake Winnipeg the catching of fish, their transport to market, and other associated industries furnish employment to large numbers of the inhabitants surrounding the lake and this industry is of considerable importance in the province. Transportation is of course an essential requirement to the success of commercial fishing and it is chiefly on that account that the inland waters to the east of this lake have not been fished. Practically all the larger lakes through the entire district are well stocked with whitefish, tulabi, jackfish, and pickerel and large quantities of these fish could readily be obtained if any serious attempt were made to fish the lakes. Lake trout and sturgeon are also found at places, though they are not so frequent. In size and quality the whitefish of these inland waters equal those caught in lake Winnipeg while the inland tulabies are much superior, being on an average three times larger.

Of the more important lakes in the region of the line known to be well stocked with these fish, the following may be mentioned: Snowshoe lake on Oiseau river, Garner, Obukowin, Carroll and Sasaginnigak lakes, the lake system around Little Grand Rapids, and probably the most important of all, a large unnamed lake (locally called "Big Clearwater") just west of the line on one of the tributaries of Poplar river. On account of the remoteness of these

lakes from markets and there being no suitable method of transportation from them little inland fishing has taken place beyond what is necessary for local requirements for food or dog feed. The possibility of the construction of a winter road from Sasaginnigak lake overland to lake Winnipeg for this purpose has already been reported to be under consideration, though nothing further has so far been done.

Water-Power Possibilities

With the growing scarcity of coal not only for fuel but also for the necessary supply of power to meet our constantly increasing demand, the water-powers of this district must sooner or later be developed and brought into use. Some idea of the extent of water power resources of this district may be gained from the fact that the district along the line is from 300 to 500 feet above the level of lake Winnipeg and that this and a considerable part of the province of Ontario is drained into lake Winnipeg by a series of rivers that are constantly passing through large lakes with storage possibilities. The waters from these rivers are literally tumbling over themselves in an uncontrolled rush down this incline to their outlet. Thousands and thousands of horse-power are now constantly going to waste and all at no considerable distance from the city of Winnipeg.

In 1915, the Dominion Water Power Branch made a reconnaissance investigation into the power possibilities of Berens, Pigeon, and Bloodvein rivers, with the following results:

BERENS RIVER

This river has a total drainage basin of approximately 7000 square miles the upper part of which lies in the province of Ontario and the lower part in the province of Manitoba. On the Ontario reach which lies above Family lake there are numerous rapids and falls which it has been estimated would be capable of producing 4000 continuous horse-power under conditions of ordinary minimum flow. Below Family lake on the Manitoba reach, six sites have been investigated by the Dominion Water Power Branch and estimates indicate these would yield 11,000 continuous horse-power under conditions of ordinary minimum flow or 13,000 horse-power with storage improvement on Family lake.

PIGEON RIVER

Pigeon river has its source in Family lake which also supplies the lower reach of Berens river. Power investigations have indicated ten feasible power concentrations which would yield a total of 24,000 continuous horse-power under conditions of ordinary minimum flow or 28,000 horse-power with storage improvement on Family lake.

BLOODVEIN RIVER

Bloodvein river has a total drainage area of approximately 2500 square miles, the upper portion of which lies in the province of Ontario and the lower

portion in the province of Manitoba. An investigation of the power possibilities of the Manitoba reach indicated three feasible power concentrations which would yield a total of 4100 continuous horse-power under conditions of ordinary minimum flow.

Mineral Resources

The geology of the line is described by Messrs. Burwash and Rickaby, as mentioned on a preceding page, in Volume XXXII, Part 2, 1923, of the Ontario Department of Mines.

Rock is so frequently encountered at the surface that it appears, at times, to be the only notable characteristic of the country. This is further accentuated by the effect of forest fires, whereby large areas have been burned bare and more

Night Owl Falls on Berens River, Main Pitch
This falls is just below Family lake. The drop is approximately 40 feet

than the usual amount of rock is now exposed to view. Most of the rock occurring along the line consists of a series of massive grey or red granite or gneiss. Thus the major part of the area does not offer much encouragement for the discovery of minerals of economic value.

From the vicinity of Oiseau river to Garner lake two other series of rocks, consisting of greenstones, conglomerates, schists, and other varieties, occur in addition to the granite along that part of the line. These are in places well mineralized and present some possibility of their bearing economic minerals. However in the immediate vicinity of the line these areas are so small in extent that it is improbable that any considerable quantity of economic mineral could ever be produced. These mineralized areas extend, however, both ways from the line and, though they have not been investigated or examined to any extent

in the province of Ontario, the same formations are known to occur in the vicinity of Red lake about 40 miles east. To the west of the line a very considerable area of this mineralized rock occurs. This has occasioned much prospecting and some development principally along Oiseau river and in the vicinity of Manigotagan and Wanipigow rivers. This entire district is now commonly referred to as Rice Lake Mining district and some valuable discoveries of gold have been made here, some, in fact, being found within 4 miles of the boundary. Mining operations have been commenced about 20 miles from the line at two or three points and winter roads almost reaching the line have been opened to this district both from Fort Alexander and Manigotagan. While gold has been mined and a few bricks shipped out of the country and there are frequent evi-

SHINING FALLS ON PIGEON RIVER

Thirty-foot falls on Pigeon river, immediately below Family lake. Pigeon river and Berens river are both outlets of Family lake

dences of its occurrence through the district, the mining of it has not up to the present appeared to have been successful. This may be due to a lack of sufficient capital to enable a thorough investigation of the position and extent of the ore bodies before mining is actually undertaken and definite results produced. Certainly, in comparison with the amount of prospecting and development work that is ordinarily carried on in advance of mining in the now producing gold-mining districts farther east in Ontario, it does not appear as though mining had been begun here energetically.

Prospecting is, however, being vigorously carried on and more recently has been extended to an area possessing some attraction immediately to the north towards Bloodvein river. This is in the province of Manitoba, and the

rocks along the line opposite this place bear no indication of the proximity of this possible mining area.

Between miles 224 and 225 the line crosses several small, lens-shaped bodies of hornblende schist, varying in length up to 400 feet. No more of this greenstone was seen west of the line, but from the west end of Mackay lake, extending to the east into Ontario there is a large body of similar rock. Geological investigations already made show the presence of this or a similar formation around Favourable lake about 60 miles east of here, indicating probably a continuous belt of these rocks between the two localities. While there are as yet no authentic data regarding the geology of the district near the end of the line through to Island lake and across to Favourable and Deer lakes, such information as is available from traders and white trappers who have passed through this district appears to indicate that granite no longer predominates. As the survey party was returning after the completion of the boundary, a party of prospectors was met on Berens river, not far from Little Grand Rapids who had Favourable lake as their objective. They had with them provisions for two years, in addition to dogs, toboggans, and the usual prospecting equipment.

Climatic Conditions

Climatic conditions of this district, though remarkably different to what are encountered in corresponding latitudes, even as close as the other side of lake Winnipeg, are such as would be expected from conditions obtaining through that better known part of northern Ontario lying immediately to the south. The summer season is very brief, four or five and one-half months being the average period between the opening and closing of the navigation season. Ice usually disappears between the 5th and the 10th of May and after the middle of October it is unsafe to venture on any extended trip. It is reported that the smaller lakes have frozen over permanently as early as the 5th of October. Through midsummer the heat especially at noon becomes most intense frequently reaching 100° Fahrenheit, this very possibly being accentuated by the presence of so much bare exposed rock which contributes in part to the oppressively warm sultry nights that follow.

Appreciable periods of settled weather are uncommon as is also clear unclouded sky. Intense heat, cloudy misty weather, fogs, thunder showers or rainstorms, follow each other in rapid succession so that for days and even weeks at a time, there is often not one unbroken day. Through the better known district to the south, such names as Thunder bay, Rainy river and Windy point are found and there is a lake called Thunder lake in this district on Poplar river. The application of these suggestive names to topographical features has very possibly not been accidental.

The average amount of annual precipitation at the town of Kenora, for a period of 15 years is 25·2 inches with a maximum and minimum amount during the same period of 44·35 inches and 19·10 inches respectively. The monthly

precipitation for an average year at this point, including data for the city of Winnipeg and Port Arthur is shown in the following precipitation record for these places for the year 1913-14. This has been prepared by the Dominion Water Power Branch.

MONTHLY PRECIPITATION RECORD, YEAR 1913-14

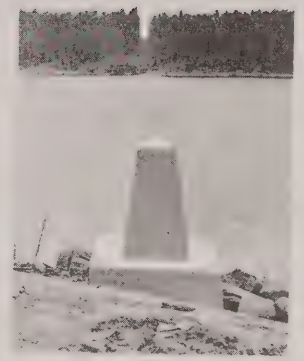
Month	Precipitation in inches		
	Winnipeg	Kenora	Port Arthur
October	0·77	3·21	3·73
November	0·75	1·35	1·27
December	0·26	0·05	0·08
January	0·79	1·30	0·97
February	0·83	0·42	0·39
March	0·59	0·36	0·94
April	0·75	1·79	1·37
May	0·53	1·87	3·43
June	1·46	4·67	1·30
July	7·14	3·80	2·30
August	2·05	2·12	4·48
September	2·28	4·07	2·70
Total	18·20	25·01	22·96

The period between the close of navigation and the commencement of actual winter is usually about 6 weeks' duration, extending to the 1st of December. During this period, commonly known as the "freezeup," travel is at a standstill and there is no intercommunication between points. A similar condition of approximately equal duration obtains during the breakup, just previous to the setting in of summer. As the ice usually holds until snow disappears, travel is not as entirely impossible as during the freezeup, although it is generally attended with considerable danger. There are brief occasions in this period when for a while in the morning after a frosty night, the crust is strong enough to carry and the slush and water on the ice is frozen. At this time, enormous loads may be drawn by the dogs without appreciable effort for a few hours only in the early morning, though the rough surface is extremely hard on their feet. These should be protected by shoes or the dogs will become so foot-sore in a few hours travel that further progress is impossible. These periods of desirable travelling conditions are most uncertain in their occurrence and frequently even those most experienced are disappointed in their non-appearance. It is customary during the latter part of the breakup to notice hunters returning t their homes overland on foot followed by their dogs but

without their sleighs or loads, they having been disappointed in the weather and forced to leave everything behind.

Generally the season through December and January is the most suitable for winter travel as the snowfall has not then reached a great depth and trails are readily followed. During February and March, the season is usually stormy, snow is continually falling, and winds are prevalent. On account of the depth of snow, trails are difficult to break out and immediately after they have been used, they are blown in and obliterated. The cold at this time becomes severe, the thermometer often standing around 50° below zero, Fahrenheit, for weeks at a time.

82



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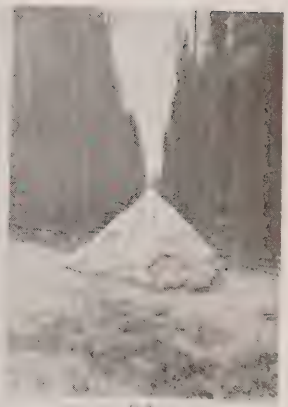

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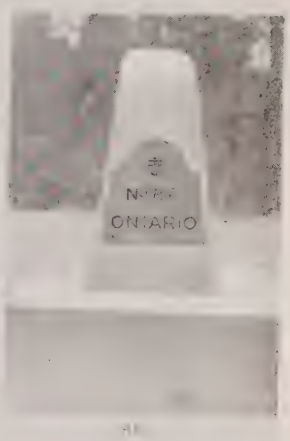

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VIEWS OF CONCRETE MONUMENTS ERECTED

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LINE SOUTH FROM 114

VIEWS OF CONCRETE MONUMENTS ERECTED

120

120

121

125

125

130

130

135

145

VIEWS OF CONCRETE MONUMENTS ERECTED

153

156

157

164

165

170

174

178

183

Views of Concrete Monuments Erected

185

187

187

190

193

196

196

201

203

VIEWS OF CONCRETE MONUMENTS ERECTED

VIEWS OF CONCRETE MONUMENTS ERECTED

APPENDIX

RESULTS OF MAGNETIC OBSERVATIONS

Locality	Station		Location of Station Distance in Chains			Tp.	Date	No. of Observations	Declination East	
	Long.	Lat.							Mean of Obsn.	Reduced to 1922·0
Winnipeg R.	95° 09′	50° 19′	1·33	S.—	Bdy. Mon. 85	16	1921·5	1	10° 20′	10° 17′
Ryerson L.	95 09	50 23		At	" 89	16	1921·5	1	9 20	9 17
Near a lake	95 09	50 29	17·47	N.—	" 94	17	1921·5	1	9 02	8 59
Near a lake	95 09	50 30	45·68	N.—	" 95	18	1921·5	1	9 32	9 29
Near a lake	95 09	50 32	3·14	S.—	" 97	18	1921·5	1	9 28	9 26
Snowshoe L.	95 09	50 34	41·80	S.—	" 98	18	1921·6	1	7 56	7 54
Snowshoe L.	95 09	50 34	29·80	S.—	" 98	18	1921·6	1	10 09	10 07
Near a lake	95 09	50 37		At	" 100	19	1921·6	1	9 32	9 30
Bee L.	95 09	50 42	38·07	N.—	" 104	20	1921·6	1	10 08	10 06
Near a lake	95 09	50 57	70·55	N.—	" 118	23	1921·7	1	9 51	9 49
Manigotagan R.	95 09	50 59		At	" 121	23	1921·7	1	10 05	10 03
Obukowin L.	95 09	51 04		At	" 125	24	1921·7	1	10 24	10 22
Craven L.	95 09	51 14	82·66	N.—	" 132	26	1921·8	1	10 08	10 07
Bloodvein R.	95 09	51 18		At	" 138	27	1922·4	1	9 23	9 25
Bloodvein R.	95 09	51 20	34·25	S.—	" 140	27	1922·4	1	8 45	8 47
Bloodvein R.	95 09	51 20	22·25	S.—	" 140	27	1922·4	1	9 24	9 26
Burriss L.	95 09	51 21	0·36	S.—	" 141	27	1922·4	1	8 48	8 50
Artery L.	95 09	51 23	1·93	N.—	" 142	28	1922·4	1	10 17	10 19
At a station	95 09	51 25	0·29	N.—	" 144	28	1922·4	1	9 43	9 45
At a station	95 09	51 26	57·43	S.—	" 145	28	1922·4	1	7 46	7 48
MacGillivray L.	95 09	51 27	5·61	N.—	" 146	29	1922·5	1	8 54	8 56
Near a lake	95 09	51 28	0·10	N.—	" 147	29	1922·5	1	7 02	7 05
Near a lake	95 09	51 33	47·93	S.—	" 151	30	1922·5	1	7 43	7 46
Near a lake	95 09	51 33	9·49	S.—	" 151	30	1922·5	1	8 24	8 27
Rundle L.	95 09	51 36	20·17	S.—	" 153	30	1922·5	1	7 43	7 46
Rundle L.	95 09	51 28	38·26	S.—	" 154	31	1922·5	2	8 57	9 00
Clayton L.	95 09	51 39	0·09	S.—	" 156	31	1922·5	1	8 27	8 30
Frances L.	95 09	51 42	39·72	N.—	" 157	31	1922·5	1	8 28	8 31
Frances L.	95 09	51 42	25·76	S.—	" 158	31	1922·5	1	8 58	9 01
Frances L.	95 09	51 43	58·24	N.—	" 158	32	1922·5	1	8 24	8 27

RESULTS OF MAGNETIC OBSERVATIONS—*Continued*

Locality	Station		Location of Station Distance in Chains	Tp.	Date	No. of Observations	Declination East	
	Long.	Lat.					Mean of Obsn.	Reduced to 1922·0
Near a lake	95 09	51 44	1·71 N.— "	160	32	1922·5	1	9 24	9° 27′
Cavanagh L.	95 09	51 48	0·25 S.— "	163	33	1922·5	2	6 39	6 42
Near a lake	95 09	51 49	85·88 S.— "	164	33	1922·5	1	7 43	7 46
Cavanagh L.	95 09	51 51	3·78 S.— "	165	33	1922·5	1	8 04	8 07
Cavanagh L.	95 09	51 51	1·24 N.— "	165	33	1922·5	1	10 18	10 21
Cavanagh L.	95 09	51 52	0·11 N.— "	166	33	1922·6	1	7 14	7 17
Near a lake	95 09	51 54	29·36 S.— "	168	34	1922·6	7	10 35	10 38
Near a lake	95 09	51 54	31·07 S.— "	169	34	1922·6	1	11 39	11 42
Packman L.	95 09	51 56	74·70 N.— "	169	34	1922·6	1	7 46	7 49
Moar L.	95 09	51 57	24·66 S.— "	171	34	1922·6	1	6 45	6 48
Moar L.	95 09	51 58	At "	172	34	1922·6	1	7 03	7 06
Moar L.	95 09	51 59	25·21 N.— "	172	35	1922·6	1	7 35	7 38
Moar L.	95 09	52 01	30·30 S.— "	175	35	1922·6	1	6 50	6 53
Moar L.	95 09	52 03	44·70 N.— "	175	35	1922·6	1	8 40	8 43
Flett L.	95 09	52 04	56·67 N.— "	176	35	1922·6	3	7 13	7 16
Pascall L.	95 °09′	52° 06′	38·76 N.—Bdy.Mon.	178	36	1922·6	1	9° 23′	9 26
Pascall L.	95 09	52 07	0·07 N.— "	180	36	1922·6	1	8 18	8 21
Goldthorpe L.	95 09	52 09	51·92 S.— "	181	37	1922·6	1	8 09	8 12
Goldthorpe L.	95 09	52 09	19·86 S.— "	181	37	1922·6	1	8 47	8 50
Bradburn L.	95 09	52 10	68·83 N.— "	182	37	1922·6	1	8 14	8 17
Bradburn L.	95 09	52 12	0·28 S.— "	184	37	1922·6	1	9 09	9 12
Bradburn L.	95 09	52 13	26·49 S.— "	185	37	1922·6	1	10 14	10 17
Ritchie L.	95 09	52 14	10·15 N.— "	186	38	1922·6	1	9 02	9 05
Ritchie L.	95 09	52 16	0·10 N.— "	187	38	1922·6	1	8 43	8 46
Ritchie L.	95 09	52 16	0·25 S.— "	188	38	1922·6	1	8 02	8 05
Laronde L.	95 09	52 18	0·32 N.— "	189	38	1922·6	1	8 02	8 05
Laronde L.	95 09	52 18	5·39 S.— "	189	38	1922·6	1	9 03	9 06
Hamilton L.	95 09	52 20	19·61 N.— "	190	39	1922·7	1	8 35	8 39
Hamilton L.	95 09	52 20	40·14 S.— "	191	39	1922·7	1	7 29	7 33
Hamilton L.	95 09	52 20	0·11 N.— "	191	39	1922·7	1	7 44	7 48
Sparrow-hawk L.	95 09	52 22	27·95 N.— "	192	39	1922·7	1	8 12	8 16
Sparrowhawk L.	95 09	52 22	11·21 N.— "	193	39	1922·7	1	9 42	9 46
Assapan L.	95 09	52 24	0·12 N.— "	194	39	1922·7	1	8 29	8 33
Assapan L.	95 09	52 24	21·57 N.— "	194	39	1922·7	1	8 09	8 13
Assapan L.	95 09	52 25	68·84 N.— "	194	40	1922·7	1	7 56	8 00

RESULTS OF MAGNETIC OBSERVATIONS—*Concluded*

Locality	Station		Location of Station Distance in Chains	Tp.	Date	No. of Observations	Declination East	
	Long.	Lat.					Mean of Obsn.	Reduced to 1922·0
Assapan L.	95 09	52 26	76·56 S.— " 196	40	1922·7	1	7 57	8 01
Assapan L.	95 09	52 26	51·59 S.— " 196	40	1922·7	1	8 00	8 04
Assapan L.	95 09	52 26	14·84 S.— " 196	40	1922·7	1	7 06	7 10
Assapan L.	95 09	52 26	0·12 N.— " 196	40	1922·7	1	7 01	7 05
At a lake	95 09	52 28	At " 198	40	1922·7	1	8 17	8 21
Marila L.	95 09	52 28	42·35 N.— " 198	40	1922·7	1	8 01	8 05
Marila L.	95 09	52 29	45·79 S.— " 199	40	1922·7	1	7 57	8 01
Marila L.	95 09	52 29	4·74 S.— " 199	40	1922·7	1	8 08	8 12
Marila L.	95 09	52 30	40·54 N.— " 200	41	1922·7	1	6 11	6 15
Marila L.	95 09	52 31	45·91 S.— " 201	41	1922·7	1	8 19	8 23
Marila L.	95 09	52 32	0·32 N.— " 201	41	1922·7	3	7 53	7 57
Near Lake No. 71.	95 09	52 32	0·16 N.— " 202	41	1922·7	1	8 26	8 30
Meandrine L.	95 09	52 34	23·12 N.— " 203	41	1922·7	1	9 48	9 52
Meandrine L.	95 09	52 34	39·62 N.— " 203	41	1922·7	1	8 33	8 37
Meandrine L.	95 09	52 34	41·80 S.— " 204	41	1922·7	1	8 42	8 46
Meandrine L.	95 09	52 35	22·07 S.— " 204	41	1922·7	1	8 12	8 16
Meandrine L.	95 09	52 35	21·12 N.— " 204	42	1922·7	1	10 04	10 08
Meandrine L.	95 09	52 36	30·38 S.— " 205	42	1922·7	1	8 56	9 00
Meandrine L.	95 09	52 36	31·97 N.— " 205	42	1992·7	1	8 32	8 36
Mackay L.	95 09	52 38	1·56 N.— " 208	42	1922·7	1	8 11	8 15
Mackay L.	95 09	52 39	44·33 N.— " 208	42	1922·7	1	8 27	8 31
Perreault L.	95 09	52 40	72·02 S.— " 209	42	1922·7	2	8 43	8 47
Perreault L.	95 09	52 40	29·59 S.— " 209	42	1922·7	1	7 48	7 52
Palsen L.	95 09	52 40	0·08 N.— " 209	42	1922·7	1	9 33	9 37